

The Neuroscience of Inspirational Leadership: The Importance of Collective-Oriented Language and Shared Group Membership

Pascal Molenberghs

Monash University

Guy Prochilo

Niklas K. Steffens

University of Queensland

Hannes Zacher

University of Groningen

S. Alexander Haslam

University of Queensland

Effective leaders are believed to inspire followers by providing inclusive visions of the future that followers can identify with. In the present study, we examined the neural mechanisms underlying this process, testing key hypotheses derived from transformational and social identity approaches to leadership. While undergoing functional MRI, supporters from the two major Australian political parties (Liberal vs. Labor) were presented with inspirational collective-oriented and noninspirational personal-oriented statements made by in-group and out-group leaders. Imaging data revealed that inspirational (rather than noninspirational) statements from in-group leaders were associated with increased activation in the bilateral rostral inferior parietal lobule, pars opercularis, and posterior midcingulate cortex: brain areas that are typically implicated in controlling semantic information processing. In contrast, for out-group leaders, greater activation in these areas was associated with noninspirational statements. In addition, noninspirational statements by in-group (but not out-group) leaders resulted in increased activation in the medial prefrontal cortex, an area typically associated with reasoning

Acknowledgments: This article was accepted under the editorship of Deborah E. Rupp. The authors would like to acknowledge helpful comments on previous versions of this manuscript from Andrew Neal; from the editor, Fred Oswald; and from two anonymous reviewers. The work was supported by ARC Early Career Research Award DE130100120 and ARC Discovery Grant DP130100559 awarded to Pascal Molenberghs.

Corresponding author: Pascal Molenberghs, School of Psychological Sciences, Monash University, Melbourne, VIC 3800, Australia.

E-mail: pascal.molenberghs@monash.edu

about a person's mental state. These results show that followers processed identical statements qualitatively differently as a function of leaders' group membership, thus demonstrating that shared identity acts as an amplifier for inspirational leadership communication.

Keywords: *leadership; fMRI; social neuroscience; group membership; social identity; transformational leadership; semantic processing; theory of mind; mentalizing; mirror system; attention; confirmation bias; cognitive dissonance*

The inspirational slogans used in Barack Obama's successful 2008 presidential campaign—"Change we can believe in" as well as "Yes we can"—were intended to create an inspiring collective-oriented vision of the future that American voters could identify with. The science of leadership has provided strong support for the notion that inspirational leaders are those who offer a vision for the future that speaks to shared concerns of the collective. Moreover, in an attempt to provide a deeper understanding of these key elements in the leadership process, a growing literature has examined the neurological substrates and brain functioning of those leaders who are believed to be particularly inspirational (Lee, Senior, & Butler, 2012; Waldman, Balthazard, & Peterson, 2011a). However, the neuroscientific mechanisms accounting for these effects in *followers*—that is, in those who are the ultimate proof of leaders' inspiration—are largely unknown. This is the issue that the present research seeks to address.

To do this, we employed functional MRI (fMRI) to examine the neuroscientific substrates of followers' responses as a function of (a) inspirational statements (inspirational collective oriented vs. noninspirational personal oriented; Howell & Shamir, 2005) and (b) shared group membership between followers and leaders (Haslam, Reicher, & Platow, 2011; D. van Knippenberg, 2011). In this way, the present research extends previous understanding in at least three important ways. First, it contributes to an emerging literature that is starting to uncover the neuroscience that is implicated in organizational life more generally (Becker, Cropanzano, & Sanfey, 2011) and in leadership and followership in particular (Lee et al., 2012; Waldman, Balthazard, & Peterson, 2011b). It also complements previous work that has explored neurological substrates in leaders who are perceived to be particularly inspirational or transformational (Balthazard, Waldman, Thatcher, & Hannah, 2012; Waldman et al., 2011a). This is achieved by providing a more comprehensive picture of the link between leaders and followers with a view to shedding light on the neurological mechanisms that underlie *followers' responses* to inspirational leadership. Second, it extends previous research on the neuroscience of leadership that has provided evidence from electroencephalogram (EEG) data of the role of varying degrees of general brain connectivity and leadership effectiveness (Lee et al.; Waldman et al., 2011a). Through the application of fMRI, the present research is able to examine the role of more detailed and precise *spatial* neurological areas and mechanisms that are involved in the processing of inspirational (and noninspirational) leader messages. Third, it expands upon a substantial body of research that has pointed to the important role that self-categorization processes play in leadership and followership (for recent reviews, see Haslam et al.; Hogg, van Knippenberg, & Rast, 2012; D. van Knippenberg) in being one of the first investigations that explore the neuroscientific substrates of these processes.

Leaders' Collective-Oriented Inspirational Rhetoric

Effective leaders portray a collective-oriented vision for the future by engaging with a superordinate collective identity between them and their followers. Research informed by both transformational leadership and the social identity approach to leadership suggests that this is often achieved by (a) making salient the role of followers as key elements of future collective success, (b) making personal sacrifices for the group, and (c) engaging in the rhetorical use of “we” and “us” to encourage followers to see themselves as implicated in the leader’s vision (Avolio, Bass, & Jung, 1999; Bass & Riggio, 2006; Howell & Shamir, 2005; Reicher, Haslam, & Hopkins, 2005; Seyranian, 2014; Shamir, House, & Arthur, 1993; B. van Knippenberg & van Knippenberg, 2005). Personal-oriented visions, on the other hand, are characterized by self-interest on the part of leaders, such that the leader focuses on his or her authority and personal role in achieving successful visionary outcomes (Howell & Shamir; Shamir et al.). Leaders who use these personal-oriented visions appear to be more self-aggrandizing, aggressive, and arrogant and are more inclined to use self-referencing that includes singular pronouns such as “I” and “me.”

Research in the tradition of social identity theorizing substantiates these claims by asserting that followers perceive a leader’s vision to be inspirational to the extent that it speaks to, and for, the group of which they and the leader are members. In this regard, it is those leaders who focus on “the group” (rather than on themselves) and, thus, create a shared identity with would-be followers, who are most capable of inspiring followers (Haslam & Platow, 2001). Supporting this proposition, a recent study found that the success of Australian political leaders was predicted by the extent to which they used collective-oriented (we- or us-referencing) rather than personal-oriented (I- or me-referencing) language (Steffens & Haslam, 2013). Results showed that in 80% of the 43 elections since 1901, the candidates who used the most collective-oriented language in their official election speech were the victors (Steffens & Haslam). Does this mean that followers will inevitably embrace leaders’ ideas when their rhetoric is collective oriented and inspirational? We would suggest that this depends on the relationship between leader and follower and their (emergent) perceptions of shared group membership.

Shared Group Membership as a Catalyst of Follower Responses

In addition to studies of the rhetoric of more or less skillful leaders, an emerging literature provides evidence for the important role of both followers and group identity in the leadership process (Day, Gronn, & Salas, 2006; Haslam et al., 2011; Hogg et al., 2012; Howell & Shamir, 2005; Kark, Shamir, & Chen, 2003; D. van Knippenberg, 2011; Wang & Howell, 2010; Yammarino, Salas, Serban, Shirreffs, & Shuffler, 2012). In this regard, one approach that has seen these elements as central to the leadership process is the social identity approach (building on social identity and self-categorization theories; after Ashforth & Mael, 1989; Ellemers, 2012; Haslam, 2004; Hogg & Terry, 2001; Tajfel & Turner, 1979; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). This asserts that people’s sense of self can be defined not only in terms of personal identity (“I”) but also in terms of social identity (“us”). In this respect, categorization of self and others in terms of a relevant shared social identity (e.g., as “us leadership scholars”) is the basis for social influence and the cornerstone of leadership and followership processes (Turner, 1991).

Empirical evidence has generated considerable support for these ideas (for reviews, see Haslam et al., 2011; Hogg et al., 2012; D. van Knippenberg, 2011). For instance, research has indicated that when followers perceive themselves to share group membership with a given leader, they are more likely (a) to be influenced by the leader's proposals (McGarty, Haslam, Hutchinson, & Turner, 1994), (b) to support the leader (Graf, Schuh, Van Quaquebeke, & van Dick, 2012; Ullrich, Christ, & van Dick, 2009), (c) to perceive the leader as charismatic (Platow, van Knippenberg, Haslam, van Knippenberg, & Spears, 2006; Steffens, Haslam, & Reicher, 2014; van Dijke & De Cremer, 2010), and (d) to respond creatively to what the leader has to say (Hirst, van Dick, & van Knippenberg, 2009).

Recent neuroimaging research has also started to uncover the neural mechanisms that are implicated in the impact of shared group membership on key psychological processes. Along these lines, previous fMRI studies have shown that modality-specific brain networks are activated differently when people process the very same categories (Molenberghs & Morrison, 2014), actions (Molenberghs, Halász, Mattingley, Vanman, & Cunnington, 2012), faces (Van Bavel, Packer, & Cunningham, 2011), and emotions (Molenberghs et al., 2014; Xu, Zuo, Wang, & Han, 2009), depending on whether these relate to in-group or out-group members. In sum, neuroimaging studies show consistently that it is not a single brain network that is involved in in-group favoritism. Rather, neural modulation by group membership occurs in different brain networks specific to the modalities involved (e.g., modulation of the action-perception network if actions are involved; Molenberghs, 2013). Similarly, we propose that neural networks involved in controlling semantic processing will be differentially implicated in followers' responses to collective-oriented inspirational messages as a function of the shared group membership between leader and follower.

More specifically, we hypothesized that people would engage in increased semantic processing of information conveyed in inspirational (vs. noninspirational) messages when these originate from an in-group leader, while the reverse would be true for an out-group leader. Research in cognitive psychology has shown that people tend to have a preference to encode information that is in agreement with their existing beliefs, a phenomenon known as confirmation bias (Nickerson, 1998). In particular, people represent information in schemas (cognitive categories that represent prototypical instances of a given stimulus) and use these to selectively encode information to which they are exposed (Fiske & Taylor, 2008). Relevant to this study, previous research informed by leader categorization theory has shown that followers have schemas about what leaders are like that they then use to selectively encode information received from a particular leader (Shondrick, Dinh, & Lord, 2010).

According to social identity theory, people derive much of their sense of self from the groups to which they belong and are motivated for this self-concept to be positive and distinctive (i.e., such that they see their in-group as different from and superior to comparison out-groups; Tajfel & Turner, 1979). One way in which this can be achieved is by selectively processing more inspirational information from an in-group leader and more noninspirational information from out-group leaders. Integrating these arguments, we hypothesized that people would be more likely to encode information when both the source and content of information are in line with normative expectations and striving for self-enhancement—that is, when in-group sources convey collective-oriented inspirational messages and out-group sources communicate noninspirational personal-oriented messages. In order to test these ideas, we relied on fMRI data that have the unique advantage of providing insights into the

neural activation in brain regions that are typically involved in controlling semantic processing.

The Neuroscience Underlying Inspirational Leadership

Although leaders' collective-oriented rhetoric and other inspiration-inducing behaviors have been related to their capacity to galvanize follower support, the science that attempts to examine the neurological mechanisms that underline these effects is only just starting to emerge (for reviews, see Becker et al., 2011; Lee et al., 2012; Waldman et al., 2011b). For example, a recent fMRI study by Boyatzis and colleagues (2012) found that when people recalled memories associated with resonant rather than dissonant leaders, they showed greater activation in brain areas such as the bilateral insula, right inferior parietal lobe, and left superior temporal gyrus. Beyond this, however, previous neuroscience research has focused mainly on testing the neurological substrates of leaders' activities. In particular, research has used power spectral analysis measures based on EEG to differentiate the brain activity of leaders who have a complex representation of their self-concept from that of leaders with a less complex representation (Hannah, Balthazard, Waldman, Jennings, & Thatcher, 2013). EEG has also been used to differentiate between the brain activity of inspirational versus noninspirational leaders (Waldman et al., 2011a) and transformational versus non-transformational leaders (Balthazard et al., 2012). While previous research has examined the neurological substrates of leaders who are perceived to be inspirational, the neurological mechanisms of *followers*—that is, those who perceive leaders to be inspirational and who ultimately work to turn their visions into reality—remain largely uncharted.

In this regard, a key concern for the leadership field has been to understand when and why followers connect (or for that matter fail to connect) with the inspirational collective-oriented vision of a leader. In the case of Obama, for example, it was apparent that not everyone was inspired by his vision of “us” as evidenced by fierce opposition from Republicans, leading to a temporary government shutdown in October 2013. Albeit on a larger stage, this experience is emblematic of what most (if not all) leaders experience day in, day out insofar as some followers are “on board” but others are not. Previous research suggests that leaders' ability to inspire followers to contribute to shared goals varies as a function of the degree to which those would-be followers categorize themselves and their leaders in terms of shared group membership (Ellemers, De Gilder, & Haslam, 2004; Haslam et al., 2011; Hogg et al., 2012; D. van Knippenberg, 2011; D. van Knippenberg, van Knippenberg, De Cremer, & Hogg, 2004). However, our understanding of the neural mechanisms that are associated with the potential modulation of inspirational leadership by self-categorization processes is very limited (Waldman et al., 2011b).

The Present Research

The aim of the present study was to investigate how the neural mechanisms involved in controlling semantic processing in followers are influenced by different inspirational leadership statements. To this end, we conducted an fMRI study to examine how followers' process collective-oriented inspirational and personal-oriented noninspirational statements as a function of shared group membership between leader and follower. In this way, the research

allowed us to test alternative hypotheses derived from transformational leadership (Bass & Riggio, 2006; Howell & Shamir, 2005; Shamir et al., 1993) and social identity theorizing (Haslam et al., 2011; Hogg et al., 2012; D. van Knippenberg, 2011).

Semantic processing involves participants processing the meaning of a word or sentence. This is typically contrasted to phonological processing in which one merely processes the syllables in a word or sentence but not their meaning (Vigneau et al., 2006). In the prefrontal cortex, semantic processing is typically associated with the ventral part of the brain, such as the pars opercularis, while phonological processing is typically associated with more dorsal parts of the prefrontal cortex (Vigneau et al.). Similarly, in more posterior parts of the brain, phonological analysis is typically performed in the posterior region of the superior temporal gyrus, while the meaning is typically processed in the inferior parietal lobule (Friederici, 2011; Price, 2012; Vigneau et al.). A recent review on the topic suggested that the role of the pars opercularis in semantic processing is not due to its involvement in complex syntax processing but rather to its critical role in cognitive control and working memory (Rogalsky & Hickok, 2011). In addition, a recent meta-analysis confirmed the role of the inferior parietal lobule and ventral prefrontal cortex in executive control to semantic information (Noonan, Jefferies, Visser, & Ralph, 2013). This suggests that these areas are more likely to play a role in controlling attention to process specific semantic information rather than process the syntax of a particular sentence. Therefore, if people are motivated to focus more on a particular message, greater activation is expected in these areas (i.e., greater activation in the pars opercularis and inferior parietal lobule). Note that this does not mean that people understand the meaning (i.e., comprehend) of a particular message more than another but rather that they are more motivated to focus on the semantics of a particular message and to engage with its content.

Transformational leadership theory predicts we would engage with a leader's collective-oriented inspirational messages regardless of the group membership of the leader. On this basis, we derive the following hypothesis:

Hypothesis 1: Compared to personal-oriented noninspirational messages, collective-oriented inspirational messages will lead to increased activation in the (a) pars opercularis and (b) inferior parietal lobule, regardless of whether they originate from an in-group or an out-group leader.

In contrast, social identity theory predicts that group membership will moderate the way in which people process inspirational collective-oriented information. According to social identity theory, when group membership is salient, people strive to achieve a positive social identity—in part through positive comparisons with competing out-groups (Tajfel & Turner, 1979). In the present case, social identity theory thus predicts that participants would focus more on the semantic information of inspirational in-group messages and noninspirational out-group messages. This will tend to consolidate their beliefs about the superiority of their political in-group and the inferiority of the political out-group. On the basis of social identity theory, we therefore derive the following hypothesis:

Hypothesis 2: Compared to personal-oriented noninspirational messages, collective-oriented inspirational in-group messages will lead to increased activation in the (a) pars opercularis and (b) inferior parietal lobule when they originate from an in-group leader. In contrast, compared to collective-oriented inspirational in-group messages, personal-oriented noninspirational

messages will lead to increased activation in the (c) pars opercularis and (d) inferior parietal lobule when they originate from an out-group leader.

Because it provides a direct measure of the underlying neural processes, fMRI provides a unique tool to test these alternative predictions. We tested these ideas in a study conducted in the context of the 2013 Australian federal election (i.e., 1–8 weeks prior to the election). Specifically, we examined participants who defined themselves as strong supporters of one of the two main parties in Australian politics (Labor or Liberal) while at the same time defining themselves as nonsupporters of the alternative party. Participants were then presented with several inspirational collective-oriented and noninspirational personal-oriented statements made by in-group and out-group political leaders (i.e., leaders of the Labor and Liberal parties) and indicated the degree to which they were inspired by each statement while undergoing fMRI.

Method

Pilot Study

The purpose of this study was to develop inspirational collective-oriented and noninspirational personal-oriented visionary statements that would be perceived as more or less inspirational (in the absence of information about the source) and that would serve as stimuli during the fMRI experiment.

Participants

Twenty participants took part in the pilot experiment (9 males, 11 females; mean age = 22.6 years, range = 19–26). Participants were reimbursed AU\$10 for their participation.

Measures

Visionary leadership statements. The primary measure in this study was a 204-item battery of visionary leadership statements that comprised 102 inspirational collective-oriented statements (e.g., “For any one of us to succeed we must succeed as a nation united”) and 102 noninspirational personal-oriented statements (e.g., “If my government is to achieve anything I must play a central role”). Participants rated the extent to which they found each statement to be inspiring (“This leader has an inspiring vision”) on a scale ranging from 0 (*I totally disagree*) to 10 (*I totally agree*). Each statement was developed with reference to the extreme ends of the criteria articulated by Howell and Shamir (2005), Shamir et al. (1993), and Waldman et al. (2011a), while personal-oriented leadership was also informed by the destructive narcissism dimensions of Wink’s (1992) narcissism scale, as adapted by Sosik, Chun, and Zhu (2013). Specifically, inspirational, collective-oriented visions emphasized a collective identity and the use of collective language, while noninspirational, personal-oriented visions emphasized self-aggrandizing narcissism and included a large degree of self-reference.

Pretask information sheet. The pretask information sheet provided contextual information that participants were instructed to consider before participating in the research. Each

statement was presented as coming from “various political leaders who may play a central role in the 2013 Australian Federal Election.” Participants were instructed to imagine that these were statements that the leaders have *actually said*, for example, on television, and reflect on how they would subsequently feel.

Results

A paired *t* test revealed that attributions of inspiration (in the absence of information about the source) were significantly higher for collective-oriented statements ($M = 7.81$, $SD = 1.08$) than for personal-oriented statements ($M = 2.84$, $SD = 1.57$), $t(19) = 10.58$, $p < .001$. Because we aimed to ensure that all collective-oriented visionary statements used in the fMRI experiment were regarded as inspirational and that all personal-oriented visionary statements were noninspirational (in the absence of information about source), we selected only those collective-oriented statements with a mean score equal to or exceeding 7 ($n = 97$ statements) and those personal-oriented statements with a mean score equal to or less than 3 ($n = 60$ statements). Given that 5 was the midpoint on the scale (which ranged from 0 to 10), 7 and 3 were chosen as cutoffs because they were equidistant from 5. In this way, we ensured that all collective-oriented statements were regarded as inspirational and all personal-oriented statements were seen as noninspirational. These statements were then used to develop the stimuli for the subsequent fMRI task.

Development of Experimental Stimuli

Combinations of group categories (i.e., LNP: Liberal; or ALP: Labor) and visionary leadership statements (collective oriented and personal oriented) created four separate conditions: in-group collective oriented, out-group collective oriented, in-group personal oriented, and out-group personal oriented. Of the 157 statements deemed appropriate during pilot testing, a subset of 108 statements was selected for use in the fMRI experiment that was matched in number of words between the two conditions. These final statements consisted of 54 inspirational collective-oriented statements ($M = 7.89$, mean range = 7–10) and 54 noninspirational personal-oriented statements ($M = 2.24$, mean range = 0–3). An independent samples *t* test confirmed that there was no difference in the average number of words in collective-oriented statements ($M = 12.70$, $SD = 1.53$) and personal-oriented statements ($M = 12.35$, $SD = 1.75$), $t(106) = 1.11$, $p = .268$.

To avoid the possibility of a participant seeing the *same* statement being expressed by leaders from opposing political parties, we counterbalanced the statements across participants. To counterbalance the statements across leader group membership while maintaining equal exposure to different vision statements, we split statements into two versions of the experiment: half of the collective-oriented statements (hereafter, C1: half one; C2: half two) and half of the personal-oriented statements (hereafter, P1: half one; P2: half two) were each combined with the LNP and ALP group categories for a specific participant (i.e., Version 1: C1 + P1 combined with LNP and C2 + P2 combined with ALP for Participant 1; Version 2: C2 + P2 combined with LNP and C1 + P1 combined with ALP for Participant 2, etc.). This procedure resulted in 54 different statements per participant (27 inspirational collective-oriented statements and 27 noninspirational personal-oriented statements) and allowed us to use identical statements across participants for the in-group and out-group leader.

fMRI Study

Participants

Forty individuals who identified strongly as either Liberal ($n = 20$; 10 males, 10 females) or Labor ($n = 20$; 10 males, 10 females) supporters (mean age = 20.6 years, range = 17–33) took part in the main experiment. Potential participants responded to the following four items: “I like the politicians from the Labor/Liberal Party” and “I identify myself more with the Labor/Liberal Party.” Participants who indicated either a 6 or 7 for identification ($M = 6.73$, $SD = 0.45$) and liking ($M = 6.33$, $SD = 0.47$) of the in-group and either a 1 or 2 for identification ($M = 1.23$, $SD = 0.42$) and liking ($M = 1.43$, $SD = 0.50$) of the out-group on 7-point Likert scales ranging from 1 (*I totally disagree*) to 7 (*I totally agree*) were invited to take part in the final experiment. All participants gave written informed consent and received A\$30 for their participation.

Experimental Stimuli: Visionary Leadership Statements

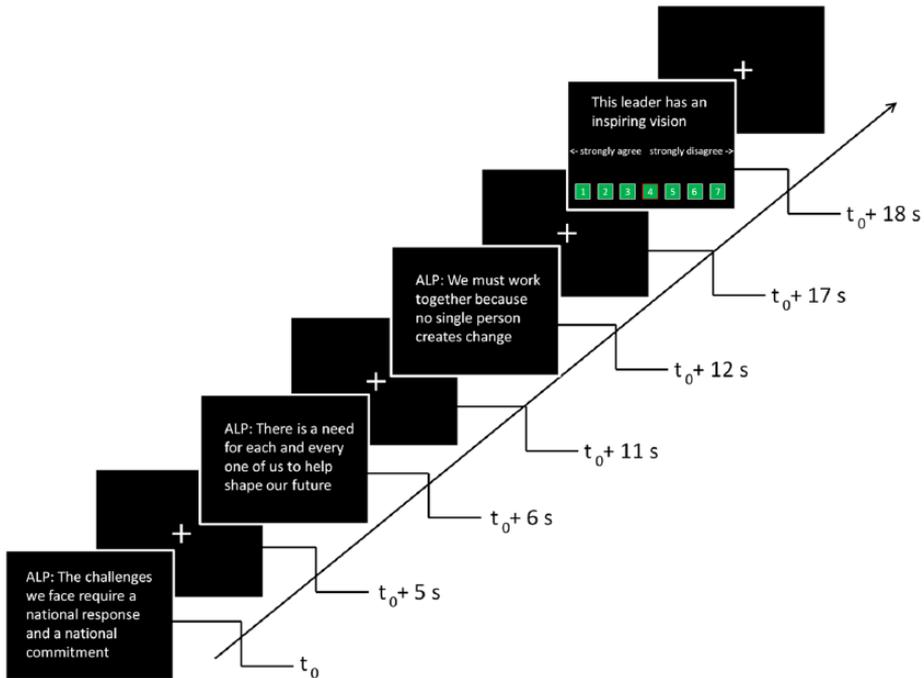
On the basis of the results of the pilot study, 54 inspirational collective-oriented and 54 noninspirational personal-oriented statements were used in the fMRI experiment. Statements were combined with leader group category descriptors representing the Labor Party (ALP) and the Liberal Party (LNP; e.g., “LNP: We will work together and shape a future of indiscriminate prosperity”).

Across the two groups, the same collective-oriented and personal-oriented statements were used, and the number of words in collective-oriented and personal-oriented statements was matched. Consequently, differences in ratings and brain activation between in-group and out-group and collective-oriented and personal-oriented statements cannot be attributed to the physical characteristics of the stimuli. To make the statements engaging and make group membership salient, we instructed participants to imagine these statements being said by Labor or Liberal leaders, for example, on television, and to reflect on how they felt about these statements.

Experimental Design and Procedure

Participants were presented with four separate conditions: in-group collective-oriented, out-group collective-oriented, in-group personal-oriented, and out-group personal-oriented statements. The four conditions were presented in blocks that involved 3 statements from the same condition (see Figure 1 for a schematic representation of a block). These statements were presented in sequence so that the fMRI data could be analyzed in a block design, which offers greater statistical power over an event-related design (Aguirre & D’Esposito, 1999). Each functional run (i.e., a certain continuous period during which participants complete a task while undergoing brain scans) consisted of 16 blocks including four repetitions of each of the four conditions, which were presented at random. In this way, during each run, 12 statements were randomly chosen from a list of 27 possible statements per condition. After each block, participants used a 7-point Likert scale to indicate how inspiring the three prior statements were (e.g., “This leader has an inspiring vision”; see Figure 1). The scale began with a red box surrounding the midpoint (Level 4 of the scale), and by pressing the left or right button, participants moved the box to their desired response. No time constraint was imposed for this behavioral response; however, all participants finished the experiment

Figure 1
Schematic Representation of a Block During the Functional MRI Experiment



Note: This representation shows the in-group collective-oriented condition for Labor participants and out-group collective-oriented condition for Liberal participants. Participants observed three leadership statements and were asked to indicate how inspiring the statements were on a 7-point scale. A fixation point at the end of each block was presented for 2 s. The statements in the figure are enlarged for display purposes. ALP = Labor Party; t = time.

before the end of each run. In total, participants completed four functional runs of around 7 min each and a high resolution structural scan (i.e., a scan during which the structure of the brain is measured in detail rather than the activation as during functional runs) was performed between the second and third functional run. Four runs were necessary to acquire sufficient data to perform reliable fMRI analysis. Each run was identical such that it consisted of 12 statements for each of the four conditions, while the statements were randomly chosen (with no repeat in the same run) from a list of 27 possible statements per condition. All experimental stimuli were presented using E-prime software (Psychology Software Tools, Inc., Sharpsburg, PA).

fMRI Image Acquisition

Our fMRI data were acquired using a 3-Tesla Magnetom Trio Siemens MRI Scanner with a 32-channel head volume coil and a gradient echo-planar imaging (EPI) sequence with the following parameters: repetition time (TR) 2.5 s, echo time (TE) 36 ms, flip angle (FA) 90°,

64 × 64 voxels at 3 × 3 mm in-plane resolution. Brain images were generated every 2.5 s, and 174 images were acquired during each functional run. Crucially, although there was no time limit to respond, all participants finished the experiment in each run before the last image was acquired. Each EPI image covered the whole brain and consisted of 36 slices per image with 10% gap between each slice. The first 4 images from each functional run were removed to allow for steady-state tissue magnetization. A 3D high resolution T1-weighted image covering the entire brain was acquired after the second run for anatomical reference (TR = 1,900 s, TE = 2.32 ms, FA = 9°, 192 cubic matrix, voxel size = 0.9 cubic mm, slice thickness = 0.9 mm).

fMRI Preprocessing

Acquired data were preprocessed and analyzed using SPM8 (Wellcome Department of Imaging Neuroscience, Institute of Neurology, London; <http://www.fil.ion.ucl.ac.uk/spm>) through MATLAB (MathWorks, Inc., Natick, MA). To correct for movement artifacts in the fMRI time series, we realigned the data to the first image of each run using a least-square solution and a six-parameter rigid-body spatial transformation. To ensure that brain regions were identical among all participants, we coregistered the T1-weighted image to the mean functional image created during realignment and normalized to the Montreal Neurological Institute (MNI) T1 template using segmentation with a voxel size of 1 × 1 × 1 mm. The same segmentation parameters were used to normalize EPI images with a voxel size of 3 × 3 × 3 mm. Finally, to render errors more normal in their distribution, we spatially smoothed the EPI images using a 9-mm full width at half maximum isotropic Gaussian filter.

fMRI Analysis

During the first-level fixed-effects analysis, a general linear model was created for each participant (Friston, Holmes, Worsley, Poline, Frith, & Frackowiak, 1994), which included the four runs and each of the four conditions. Regions with significant blood-oxygen-level-dependent changes were modeled by a block design with a duration of 17 s for each of the four conditions, time locked to the onset of each block. This 17-s window corresponded to the presentation of three statements per block (see Figure 1) but did not include the motor response. For the second-level random-effects analysis (Penny & Holmes, 2003), contrast images for each participant and for each condition from the first-level fixed-effects models were included in a 2 (leader group membership: in-group vs. out-group) × 2 (leadership statement: collective oriented vs. personal oriented) repeated-measures analysis of variance. First, a network was identified that was differently activated between the four conditions by performing the two main effects and interaction analysis. A cluster-level threshold with a familywise error (FWE) rate (p) of less than .05, corrected for multiple comparisons using all the voxels in the whole brain atlas, was used to define significant activation for these main effects and interaction analyses, and a voxel-level probability threshold (p) of less than .001 was used to define each cluster. With more than 100,000 voxels in a typical fMRI study, correcting for multiple comparisons is crucial in fMRI studies (Bennett, Wolford, & Miller, 2009). With this in mind, we opted for a conservative FWE corrected threshold in order to avoid false positives (i.e., Type I error). An FWE value of .05 keeps the number of false positives at 5% chance of one or more false positives across the entire set of tests. This yields a 95% confidence level that there are no false positives in the results.

These different significant clusters (thresholded at $p < .001$) for the main and interaction effect (see Table 1) were combined (separately for the main effect and interaction effect). These two regions of interest (ROIs) were then used in subsequent ROI analyses for follow-up comparisons. These ROI analyses thus allow us to further examine the brain regions in which activation was significantly different in our main effects and interaction analyses mentioned above. So now rather than looking at all the voxels in the brain, we focus our subsequent analysis on the ROIs that showed a difference in activation between conditions. For those not familiar with fMRI pairwise comparisons, here we directly compare activation in a certain condition with activation in another condition—for example, Condition A minus activation in Condition B. This allows us to identify whether people in Condition A show more activation in a particular brain region than those in Condition B. This analysis is specific and different from one that examines a main effect where the direction of the activation is unclear (i.e., the significant activation could come from more activation in Condition A compared to B but also from more activation in Condition B compared to A). Given that the interaction was significant, all possible follow-up pairwise comparisons were analyzed to provide a full description of our fMRI data. A voxel-level threshold with an FWE rate (p) of less than .05 corrected for the size of each ROI was used to define significant activation for all follow-up pairwise analyses, and a voxel-level probability threshold (p) of less than .05 was used to define the clusters.

Results

Behavioral Results

A 2 (leader group membership: in-group vs. out-group) \times 2 (leadership statement: collective oriented vs. personal oriented) repeated-measures analysis of variance was conducted to examine the impact of leader identity and vision on follower attributions of inspiration. Collective-oriented statements ($M = 5.54$, $SD = 0.60$) were seen to be significantly more inspirational than personal-oriented statements ($M = 2.26$, $SD = 0.68$), $F(1, 39) = 387.52$, $p < .001$, $\eta^2_p = .91$. In-group statements ($M = 4.66$, $SD = 0.66$) were seen to be significantly more inspirational than out-group statements ($M = 3.15$, $SD = 0.66$), $F(1, 39) = 74.34$, $p < .001$, $\eta^2_p = .66$. There was no significant interaction, $F(1, 39) = 1.69$, $p = .201$, $\eta^2_p = .04$.

fMRI Results

Effect of leader group membership. No significant main effect was found regarding the group membership of the leader (see Table 1A).

Effect of leadership statements. A significant main effect of leadership statements was found in left lateral orbitofrontal cortex (extending into superior temporal gyrus), left angular gyrus, and dorsal medial prefrontal cortex (see Table 1B and Figure 2). Pairwise follow-up comparisons between personal- versus collective-oriented statements revealed that the significant difference in these three regions was caused by increased activation in the personal statement conditions (see Table 1D and 1E). Contrary to Hypothesis 1, no increased activation was seen for collective-oriented inspirational messages compared to personal-oriented noninspirational messages in the (a) pars opercularis and (b) inferior parietal lobule, regardless of whether they came from an in-group or an out-group leader.

Table 1
Montreal Neurological Institute (MNI) Coordinates and Associated Peak Values for Significant Regions

Anatomical Region	Peak MNI coordinates			<i>k</i>	Z value	Peak <i>p</i>
	<i>x</i>	<i>y</i>	<i>z</i>			
A. Main effect of group membership						n.s.
B. Main effect of statement						
Left lateral orbitofrontal cortex	-57	20	7	1,252	5.68	< .001
Left angular gyrus	-54	-58	22	429	5.67	< .001
Dorsal medial prefrontal cortex	-9	20	61	514	5.05	.002
C. Interaction						
Left rostral inferior parietal lobule	-57	-34	28	407	5.36	< .001
Right rostral inferior parietal lobule	60	-31	28	618	5.90	< .001
Left pars opercularis	-42	2	10	525	5.67	< .001
Right pars opercularis	39	8	10	568	5.22	.001
Posterior midcingulate gyrus	-12	-31	43	1,460	5.48	< .001
Dorsal medial prefrontal cortex	15	35	58	134	4.69	.01
D. Collective oriented minus personal oriented						n.s.
E. Personal oriented minus collective oriented						
Left angular gyrus	-54	-58	22	429	5.79	< .001
Left lateral orbitofrontal cortex	-57	20	7	872	5.80	< .001
Left superior temporal gyrus	-51	-34	-5	379	5.38	< .001
Dorsal medial prefrontal cortex	-9	20	61	514	5.18	< .001
F. In-group collective oriented minus in-group personal oriented						
Left rostral inferior parietal lobule	-63	-31	40	370	3.94	.002
Right rostral inferior parietal lobule	60	-31	28	523	4.31	.001
Left pars opercularis	-39	-1	16	422	3.89	.003
Right pars opercularis	36	8	13	541	4.25	.001
Posterior midcingulate cortex	9	-28	46	1,167	4.50	.001
G. Out-group personal oriented minus out-group collective oriented						
Left rostral inferior parietal lobule	-63	-37	28	407	4.49	< .001
Right rostral inferior parietal lobule	54	-37	28	608	4.47	< .001
Left pars opercularis	-54	-1	13	521	4.56	< .001
Right pars opercularis	60	2	16	561	3.98	.002
Posterior midcingulate cortex	6	-1	46	1,438	4.69	< .001
H. In-group collective oriented minus out-group collective oriented						
Left rostral inferior parietal lobule	-60	-31	22	390	3.25	.019
Right rostral inferior parietal lobule	57	-34	31	610	4.07	.002
Left pars opercularis	-42	2	10	414	3.34	.018
Right pars opercularis	45	5	1	545	3.79	.005
Posterior midcingulate cortex	-9	-34	46	1,450	3.57	.023
I. In-group collective oriented minus out-group personal oriented						n.s.
J. In-group personal oriented minus in-group collective oriented						
Dorsal medial prefrontal cortex	12	35	58	128	5.33	< .001
K. In-group personal oriented minus out-group collective oriented						
Dorsal medial prefrontal cortex	9	35	55	68	2.73	.039

(continued)

Table 1 (continued)

Anatomical Region	Peak MNI coordinates			<i>k</i>	<i>Z</i> value	Peak <i>p</i>
	<i>x</i>	<i>y</i>	<i>z</i>			
L. In-group personal oriented minus out-group personal oriented						
Dorsal medial prefrontal cortex	18	35	58	128	3.77	.002
M. Out-group collective oriented minus out-group personal oriented						
Dorsal medial prefrontal cortex	18	47	49	13	2.34	.097*
N. Out-group collective oriented minus in-group collective oriented						
Dorsal medial prefrontal cortex	15	35	58	117	3.22	.010
O. Out-group collective oriented minus in-group personal oriented						n.s.
P. Out-group personal oriented minus in-group collective oriented						
Left rostral inferior parietal lobule	-60	-43	28	76	3.13	.026
Left pars opercularis	-54	-1	13	258	3.14	.032
Posterior midcingulate cortex	6	-10	70	367	3.53	.026
Q. Out-group personal oriented minus in-group personal oriented						
Left rostral inferior parietal lobule	-60	-37	28	407	4.97	< .001
Right rostral inferior parietal lobule	60	-31	28	617	4.81	< .001
Left pars opercularis	-51	-1	13	523	5.09	< .001
Right pars opercularis	36	8	13	567	4.58	< .001
Posterior midcingulate cortex	-12	-28	43	1,464	4.64	< .001

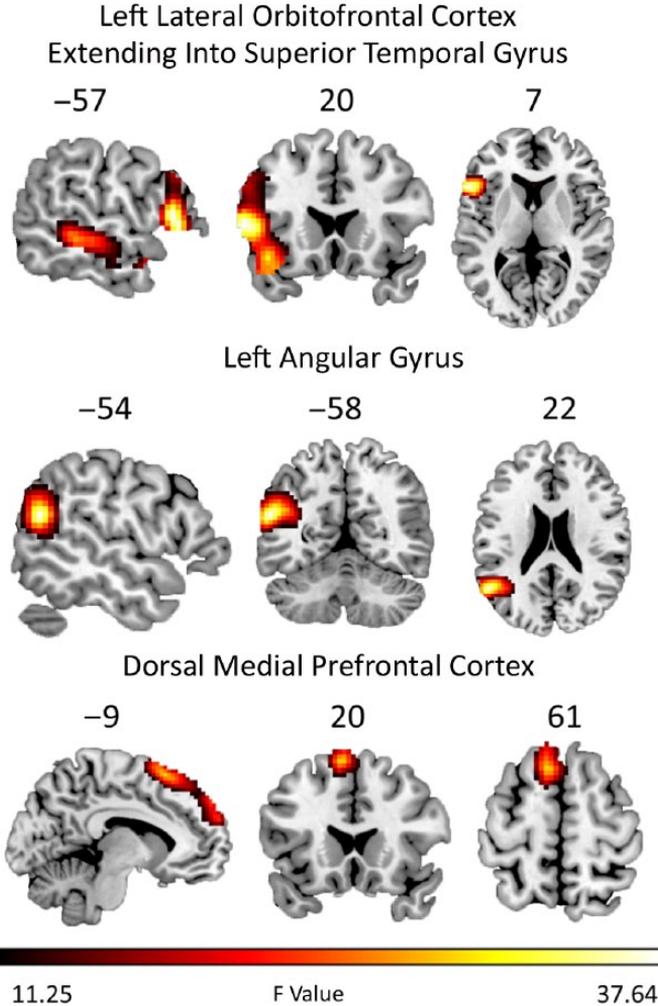
Note: Significant regions are those with a familywise error rate of less than .05 corrected.

*marginally significant ($p < .10$).

Interaction between leader group membership and leadership statement. The interaction reflected significant differences in activation in several areas, including the bilateral rostral inferior parietal lobule, bilateral pars opercularis, posterior midcingulate gyrus, and dorsal medial prefrontal cortex (see Table 1C and Figure 3). To investigate this interaction further, we performed all possible pairwise comparisons (see Table 1). These indicated that the dorsal medial prefrontal cortex revealed a different pattern than the other five significant regions. More specifically, the bilateral rostral inferior parietal lobule, bilateral pars opercularis, and midcingulate cortex were more active in the in-group collective-oriented minus in-group personal-oriented condition (see Table 1F). However, the opposite pattern was observed in out-group conditions: Here, the same regions were more active in the out-group personal-oriented minus out-group collective-oriented contrast (see Table 1G). More activation in the same areas was also found for the in-group collective-oriented minus out-group collective-oriented contrast (see Table 1H) and the out-group personal-oriented minus in-group personal-oriented contrast (see Table 1Q).

These results supported Hypothesis 2, which predicted increased activation for collective-oriented inspirational messages compared to personal-oriented noninspirational messages in the (a) pars opercularis and (b) inferior parietal lobule when they came from an in-group leader. Furthermore, consistent with Hypothesis 2, results showed increased activation for personal-oriented noninspirational messages compared to collective-oriented inspirational messages in the (c) pars opercularis and (d) inferior parietal lobule when they came from an out-group leader.

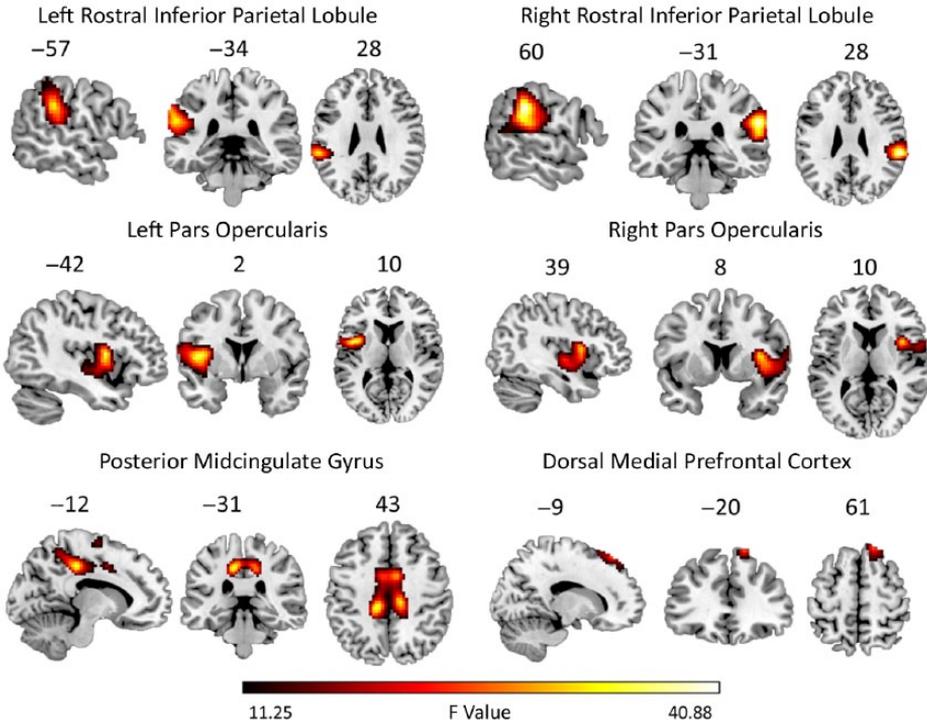
Figure 2
Significant Brain Activation From the Main Effect of Leadership Statement in Table 1B



Note: Activations are displayed on a ch2better template using MRICron (<http://www.mccauslandcenter.sc.edu/micro/mricron/>). The numbers above the sagittal, coronal, and axial slices indicate coordinates in Montreal Neurological Institute space.

A different pattern was observed in the dorsal medial prefrontal cortex. This area was activated when the in-group leader made personal-oriented rather than collective-oriented statements (see Table 1J) and when the out-group leader made collective-oriented rather than personal-oriented statements (see Table 1M). More activation was also found in this area for the out-group collective-oriented minus in-group collective-oriented contrast (see Table 1N)

Figure 3
Significant Brain Activation From the Leader Group Membership \times Leadership Statement Interaction in Table 1C



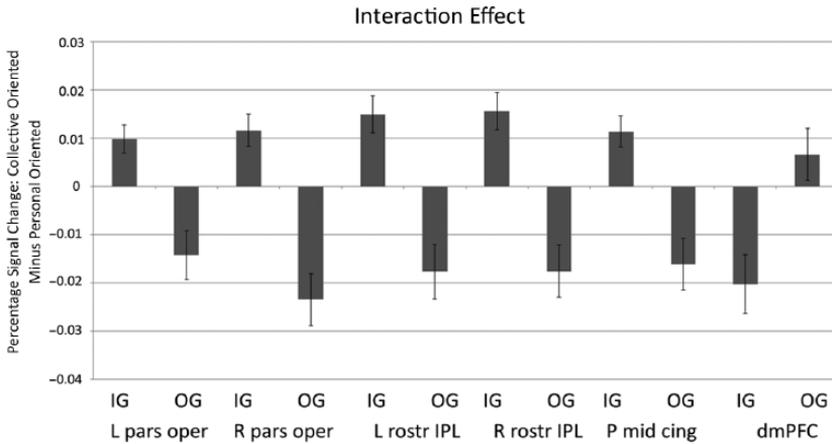
Note: Activations are displayed on a ch2better template using MRIcron (<http://www.mccauslandcenter.sc.edu/micro/micron/>). The numbers above the sagittal, coronal, and axial slices indicate coordinates in Montreal Neurological Institute space.

and the in-group personal-oriented minus out-group personal-oriented contrast (see Table 1L).

The same interaction effect is displayed in Figure 4. Here, the mean percentage signal change is extracted from all voxels using the MarsBaR software (<http://marsbar.sourceforge.net/>) for all six significant clusters and is then displayed for the collective-oriented minus personal-oriented conditions. As is clear from Figure 4, the dorsal medial prefrontal cortex had a different pattern than the other five regions.

Correlation between behavioral results and fMRI results. To establish whether participants selectively process information in a way that causes them to rate the in-group leader as more inspirational, we explicitly tested whether the behavioral in-group bias (i.e., indicating that the in-group leader was more inspirational) was associated with selective semantic processing. More specifically, to examine whether the main effect of in-group bias that we

Figure 4
Percentage Signal Change for the Collective-Oriented Minus Personal-Oriented Conditions for Each of the Significant Clusters in the Interaction Effect in Table 1C and Figure 3



Note: Error bars indicate standard errors. IG = in-group; OG = out-group; L pars oper = left pars opercularis; R pars oper = right pars opercularis; L rostr IPL = left rostral inferior parietal lobule; R rostr IPL = right rostral inferior parietal lobule; P mid cing = posterior midcingulate gyrus; dmPFC = dorsal medial prefrontal cortex.

observed in the behavioral results was underpinned by the selective processing of semantic information in the fMRI results, we correlated the amount of behavioral in-group bias ([in-group collective oriented + in-group personal oriented] – [out-group collective oriented + out-group personal oriented]) with the mean percentage signal change in the interaction effect ([in-group collective oriented + out-group personal oriented] – [out-group collective oriented + in-group personal oriented]) from the five regions (bilateral pars opercularis, bilateral rostral inferior parietal lobule, and posterior midcingulate gyrus) that showed a similar interaction effect. A one-way Pearson correlation revealed that there was a significant positive correlation between the two, $r(38) = .29, p = .035$. This indicates that to the extent that people saw the in-group leader as more inspirational than the out-group leader, they showed more activation in these five regions when collective-oriented inspirational messages were presented by the in-group leader and personal-oriented noninspirational messages were presented by the out-group leader.

Discussion

The present research was designed to investigate the neural networks associated with followers' responses to inspirational leader rhetoric. In particular, we aimed to examine competing hypotheses derived from transformational leadership research (Bass & Riggio, 2006; Howell & Shamir, 2005) and the social identity approach to leadership (Haslam et al., 2011; Hogg et al., 2012; D. van Knippenberg, 2011). On the basis of transformational leadership

theory, one would expect that followers would engage more with collective-oriented inspirational rather than personal-oriented noninspirational leader messages regardless of the group membership of the leader (Howell & Shamir; Shamir et al., 1993). Based on transformational leadership theory, Hypothesis 1 predicted increased activation in the pars opercularis and inferior parietal lobule for collective-oriented inspirational messages regardless of the leader's group membership. In contrast, based on social identity theory, Hypothesis 2 predicted an interaction such that greater activation in these areas would be seen for collective-oriented inspirational messages when they came from an in-group leader and personal-oriented noninspirational messages when they came from an out-group leader. The results clearly supported Hypothesis 2.

First, as expected, areas typically associated with controlling semantic processing were activated to a greater extent when followers were presented with inspirational collective-oriented rather than noninspirational personal-oriented messages by in-group leaders. Specifically, when followers were exposed to in-group leaders who used inspirational collective-oriented rather than noninspirational personal-oriented language (see Table 1E), more activation was found in the bilateral pars opercularis, bilateral rostral inferior parietal lobule, and posterior midcingulate cortex. However, the same contrast for out-group leaders who used inspirational collective-oriented rather than noninspirational personal-oriented language (see Table 1M) did not lead to more activation in these regions. In fact, the same regions were activated more in the *reverse* contrast when out-group leaders used personal-oriented rather than collective-oriented language (see Table 1F). As the pars opercularis and rostral inferior parietal lobule are well known for their role in controlling semantic processing (Friederici, 2011; Noonan et al., 2013; Price, 2012; Rogalsky & Hickok, 2011; Vigneau et al., 2006), these findings suggest that participants engaged in greater semantic processing of (a) inspirational collective-oriented messages from in-group leaders and (b) noninspirational personal-oriented messages from out-group leaders.

Relatedly, these two regions also correspond to areas that have been implicated in mirroring or simulating mouth movements (Buccino et al., 2001; Fabbri-Destro & Rizzolatti, 2008; Molenberghs, Cunningham, & Mattingley, 2012). Consequently, if such activation is prescriptive of mirror simulation, this may suggest that followers were more inclined to imagine an in-group leader conveying inspirational statements and an out-group leader conveying noninspirational statements. Similarly, while the cingulate cortex in general is involved in a range of different functions, the specific posterior midcingulate cortex area found to be differentially activated in the present study is commonly implicated in semantic and episodic memory recall and attention networks (Binder, Desai, Graves, & Conant, 2009; Torta & Cauda, 2011). This suggests that participants may have been more inclined to recall and pay attention to the inspirational collective-oriented messages of in-group leaders while at the same time paying more attention to the noninspirational personal-oriented messages of out-group leaders. This is in line with the view that participants processed information that was aligned with their existing beliefs.

One note of caution should be made here. While fMRI can identify which brain area is more active during a particular task, it can never allow us to conclude with total certainty that activation in a particular brain area is associated with a specific cognitive task. This problem is known as the "reverse inference" problem (i.e., engagement of a particular cognitive process is inferred from the activation of a particular brain region; Poldrack, 2006). Ways to reduce reverse inference include having clear and theory-based hypotheses about which

brain regions are expected to be involved (as in our study) and linking activation in certain areas with a behavioral control measure (Huettel & Payne, 2009). This is what we did in our correlational analysis where we analyzed whether the amount of behavioral in-group bias was associated with increased activation in the five regions found in the fMRI interaction effect. The positive correlation between the behavioral and fMRI results suggests that the behavioral main effect (i.e., rating the in-group leader's statements as more inspirational than the out-group leader's statements regardless of whether they were inspirational) is underpinned by an interaction effect in the fMRI results (i.e., processing more inspirational statements by the in-group and more noninspirational statements by the out-group). Therefore, increased activation in the pars opercularis and inferior parietal lobule can be interpreted with a relatively high degree of certainty as evidence of increased control of attention to specific semantic information because it was predicted by our a priori hypotheses and because it correlated with behavioral control measures. However, other interpretations of brain activations in this study should be seen as more speculative, given the reverse inference problem alluded to earlier.

In sum, then, the present findings provide neuroscientific evidence that is consistent with the claim that social identity is a basis for perceiving and engaging with inspirational leadership (Avolio et al., 1999; Bass & Riggio, 2006; Conger & Kanungo, 1988; Howell & Shamir, 2005; Kark et al., 2003; Shamir et al., 1993). Substantiating self-reported indicators of leader inspiration and charisma that have been employed in previous experimental research (see also Platow et al., 2006; Steffens et al., 2014; van Dijke & De Cremer, 2010; B. van Knippenberg & van Knippenberg, 2005), the present research provides tentative evidence of the more nuanced neurological information processes that are involved in such perceptions. Specifically, followers' perceptions that in-group leaders who invoked the collective in their messages were more inspirational were related to enhanced activation of brain areas that also play a role in semantic processing of information.

It is important to note that while we manipulated shared group membership in categorical terms in the present study (in that leaders were either in-group or out-group leaders), the degree to which followers perceive a leader to share group membership is not fixed but rather is negotiable, context dependent, and varies on a *continuum* (such that leaders vary in the degree that they are perceived to share and represent social identity; Haslam et al., 2011; Hogg et al., 2012; D. van Knippenberg, 2011). Relatedly, it appears that for leaders to be inspirational—in the sense not only that they are perceived as such but also that they inspire psychological engagement with their messages—they need to cultivate and embed a sense that they share social identity with would-be followers. In this regard, previous research has argued that leaders can do this (a) by clearly defining what it means to be “one of us” (e.g., through clarification of shared norms and ideals that speak to the content of shared identity; Elsbach & Kramer, 1996; Haslam et al.; Reicher et al., 2005; Reicher & Hopkins, 2001, 2003; Seyranian, 2014) and (b) by embedding a shared sense of “us” through the creation of structures and material reality that allow group members to live out shared group membership.

Finally, the present research also contributes to emerging work that is shedding greater light on the neuroscience of social and organizational behavior (Becker & Cropanzano, 2010; Becker et al., 2011; Lee et al., 2012) and of leadership and followership especially (Dinh, Lord, Gardner, Meuser, Liden, & Hu, 2014; Lee et al.; Waldman et al., 2011b). In particular, it augments our understanding of the neuroscience of inspirational leadership by

complementing previous research that has focused on the neurological processes of leaders who are generally perceived to be particularly inspirational, charismatic, or transformational (Balthazard et al., 2012; Waldman et al., 2011a). It does this by shedding light on those processes that are involved in *actual* inspiration—as experienced by followers.

In addition to our main hypotheses, neuroimaging data implicated two additional and distinct neural networks in the leadership (and followership) processes we investigated. Specifically, there was greater activation of the left lateral orbitofrontal cortex and left angular gyrus following exposure to personal-oriented statements rather than collective-oriented statements. The lateral orbitofrontal cortex (contrary to the medial orbitofrontal cortex) is typically activated in response to stimuli with negative connotations (Berridge & Kringelbach, 2013; Kringelbach & Rolls, 2004). The left lateral orbitofrontal cortex and adjacent pars triangularis together with the angular gyrus also typically respond to sentences that violate a social norm (Hagoort, Hald, Bastiaansen, & Petersson, 2004; Newman, Pancheva, Ozawa, Neville, & Ullman, 2001; Tesink, Petersson, Van Berkum, van den Brink, Buitelaar, & Hagoort, 2009).

In line with the idea that personal-oriented statements (e.g., “The nation will not succeed without my personal input in the coming years”) are generally regarded as self-aggrandizing and narcissistic (Bono & Ilies, 2006; Howell & Shamir, 2005), findings suggest not only that these are regarded as generally noninspirational but also that processing such statements is related to greater activation of areas that are associated with negative-value-laden meaning.

Finally, when followers processed noninspirational personal-oriented rather than inspirational collective-oriented statements, greater activation was observed in the dorsal medial prefrontal cortex. This area is often activated when elaborating on the mental state of another person or during so-called theory of mind or mentalizing (Amodio & Frith, 2006; Denny, Kober, Wager, & Ochsner, 2012; Eres & Molenberghs, 2013; Saxe, 2006; Schurz, Radua, Aichhorn, Richlan, & Perner, 2014; Van Overwalle, 2009). It is interesting that this area was more activated when the in-group leader made personal-oriented minus collective-oriented statements (see Table 1J) but not when the out-group leader made the same inappropriate statements (see Table 1G). This may suggest that participants were motivated to interrogate the state of mind and intentions of a leader with whom they shared group membership when that leader made statements that were self-aggrandizing rather than group oriented because it goes against the positive view that participants have about their in-group. On the other hand, it is likely that when a political leader from the opposing out-group made the same self-aggrandizing statements, this person’s mental state was not questioned because it accords with participants’ views about members of the out-group.

Our results are in line with previous neuroimaging results that have shown that people process information in a subjective way. For example, Westen, Blagov, Harenski, Kilts, and Hamann (2006) conducted an fMRI study in which they confronted participants with incriminating information about their preferred political candidate. This would logically lead to an emotionally aversive conclusion, but participants could arrive at a more positive alternative conclusion by using a “motivated reasoning” strategy (i.e., focusing on exculpatory evidence). In line with this possibility, findings by Westen et al. showed that participants preferred this “motivated reasoning” strategy more for their preferred candidate than for a nonpreferred candidate. This strategy was associated with increased activation in the lateral and medial orbitofrontal cortex, anterior and posterior cingulate cortex, and insula, which Westen et al. interpreted as a way for participants to maximize positive affect and minimize

negative affect in relation to their ideal candidate. Individual differences in brain activation in response to similar information can also predict future behavior. For example, Falk, Berkman, Mann, Harrison, and Lieberman (2010) used fMRI to show that a difference in medial prefrontal cortex activation in response to persuasive messages (i.e., messages regarding the value of regular sunscreen use) was predictive of behavioral change (i.e., increased sunscreen use) in the future. Finally, EEG data have shown that when people are presented with information that does not accord with their value system (e.g., "I think euthanasia is an acceptable/unacceptable course of action"), there is a rapid brain response (within 200 to 250 ms) that indicates a clash with the reader's value system and that subsequently also influences later components involved in the analysis of meaning (Van Berkum, Holleman, Nieuwland, Otten, & Murre, 2009). This further demonstrates that people process identical information very differently as a function of their motivation and values.

Social identity theory predicts that people strive for positive group distinctiveness and therefore are motivated to selectively process information that confirms the belief that in-group leaders are more inspirational than those of an out-group. The fMRI results support this view in showing increased activation in brain areas involved in controlling semantic processing in response to inspirational messages from in-group leaders and noninspirational messages from out-group leaders. Often, when people are confronted with messages that conflict with their preexisting beliefs (i.e., where an in-group leader is noninspirational and an out-group leader is inspirational), they experience cognitive dissonance (Festinger, 1957). Individuals strive to maintain cognitive consistency, which is a state free from mental stress and discomfort. This feeling of cognitive inconsistency has previously been associated with increased activation in the medial prefrontal cortex (for a review, see Izuma, 2013) and is in line with our fMRI results. Our self-report findings further indicated that followers judged identical messages (collective oriented and personal oriented) to be less inspirational if these were believed to be made by an out-group rather than an in-group leader. These results thus suggest that people selectively process and encode information in a manner that aligns with their existing beliefs (Fiske & Taylor, 2008; Nickerson, 1998).

Limitations and Future Research

The present research is not without limitations, and in this context, it is worth making some more general points about the methods we have used in light of the fact that many organizational psychologists and management scholars will be unfamiliar with the neuroscientific techniques we have employed.

First, in order to control for the visual characteristics of the stimuli (which is very important in fMRI research), we used generic identical verbal stimuli for in-group and out-group leaders rather than, for example, complex individualized videos of specific leaders. However, because we used these type of well-controlled stimuli and because leadership is a phenomenon that plays out in interactions between particular individuals, we lose a lot of interpersonal and nonverbal information that is also vital to leader–follower interactions (see, e.g., Butler & Geis, 1990; Darioly & Mast, 2013; Phillips & Bedeian, 1994). Future neuroscience research on leadership should further explore the influence of other (personal and nonverbal) information on leader–follower interactions.

Second, one might argue that our findings are limited because we relied on a sample size that is smaller than that typically used in other forms of experimental and survey research. In

addition to the material limits posed by the costs and labor intensity that go hand in hand with fMRI research, we would point out that (a) the present sample size (i.e., a total of 40 participants) is larger than is typically (approximately 20 participants) used in experiments of this type and (b) the present experiment used multiple trials within participants in order to be able to estimate true effects more accurately. Here we would note as well that chance alone is unlikely to explain the present findings (see also Lieberman, Berkman, & Wager, 2009) not only because our findings are consistent with theoretical hypotheses but also because the impact of the variables studied here is particularly strong (i.e., significant, FWE $p < .05$ main and interaction effects after corrections for multiple comparisons at the whole brain level). Often, similar fMRI studies use ROI analysis or uncorrected thresholds (Bennett et al., 2009; Lieberman & Cunningham, 2009; Poldrack, 2007). As such, the strong effects we found are related to our strong manipulation of two different groups. Given that participants were members of the two opposing political parties who identified strongly with their in-group and clearly disliked the out-group, we would expect these effects to be less pronounced in unselected groups (i.e., among participants who identify weakly rather than strongly with a given group).

Third, all our collective-oriented statements in the fMRI experiment were inspirational and all of our personal-oriented statements were noninspirational. We deliberately developed the fMRI experiment to have this design to maximize the difference between collective-oriented and personal-oriented statements. In addition, we made all the collective-oriented messages inspirational to optimize the opportunity for people to connect with these type of messages. As such, the inspirational collective-oriented messages are generally seen as more positive than the noninspirational personal-oriented statements. The goal of this study was simply to test the hypothesis that people would process these two types of statements differently as a function of whether they came from an in-group or out-group leader. Our results clearly support this hypothesis. However, we do not argue that people will always process collective-oriented statements more if they come from an in-group leader. For example, we predict that people would not process the statements of an in-group leader so fully (i.e., so that there would be less activation in the semantic processing network, more activation in dorsal medial prefrontal cortex) if these were collective-oriented, negative, and noninspirational statements (e.g., of the form “We should all work together to make our country worse”). However, this prediction remains to be tested. Future work should also disentangle the effects of affect (i.e., positive vs. negative), collective framing (i.e., personal oriented vs. collective oriented), and levels of inspiration (i.e., inspirational vs. noninspirational).

Fourth, we would like to stress that we are not adopting a position of “biological reductionism” or “neuroessentialism” in seeking to claim that any of the neurological mechanisms we have studied are any more scientific, important, or “real” than alternative behavioral or perceptual responses to leaders (for critical reflections, see Ashkanasy, 2013; Cropanzano & Becker, 2013; Lindebaum, 2013; Lindebaum & Jordan, 2014; McLagan, 2013). Nevertheless, we concur with previous research that has argued that neuroscientific research can add a novel and intriguing dimension to the study of leadership processes (Ashkanasy, Becker, & Waldman, 2014; Dinh et al., 2014; Lee et al., 2012; Waldman, 2013; Waldman et al., 2011b). As noted above, this is because neuroscientific examinations are able to contribute to theory not only by explaining psychological phenomena at a different (lower) level of analysis, which complements and aligns with other forms of behavioral data, but also by *testing* theory in ways that are not otherwise straightforwardly possible (see also Cacioppo & Decety, 2011; Dovidio, Pearson, & Orr, 2008).

Beyond this, the present study allowed us to test theory and garner important evidence that an important leadership construct such as inspirational collective-oriented rhetoric is not a single universal concept but, in fact, is influenced by the group membership of leaders and followers. Future neuroscience research in this domain could also focus on areas outside the political context and test these predictions within a business context instead. That said, we readily acknowledge that the present study is only a first step towards a better understanding of the neuroscience of inspirational leadership and, accordingly, is only indicative of what future neuroscientific research might contribute to our understanding of social and organizational phenomena in general and of leadership and followership in particular.

Conclusion

The present findings demonstrate that follower attributions of inspirational leadership are determined not only by inspirational features of messages but also by the group-based relationship between the leaders who make them and their would-be followers. Importantly, this research is the first to explore the neuroscience of *followers'* experiences of inspirational leader rhetoric, and here it suggests that inspirational rhetoric is processed very differently depending on the degree of shared group membership between leader and follower. We believe our results have important implications for leaders who want to communicate inspirational messages to followers in showing that shared in-group identification is important for leaders' inspirational messages to be seen as inspirational by followers. Accordingly, unless leaders can cultivate a sense of shared group membership (e.g., through acts of identity entrepreneurship; Reicher et al., 2005), their inspirational messages are likely to fall on deaf ears.

The present findings thus give neurological substance to the observation with which we started—that Barack Obama may be widely considered an inspirational speaker but may still find it hard to inspire, and to connect with, those who see him as representative of an out-group rather than an in-group. In this regard, the evidence we have presented gives some neuroscientific substance to claims that it is only when in-group leaders speak for “us” that followers embrace their pronouncements enthusiastically.

References

- Aguirre, G., & D'Esposito, M. 1999. Experimental design for brain fMRI. In P. A. Bandettini & C. Moonen (Eds.), *Functional MRI*: 369-380. Berlin: Springer Verlag.
- Amodio, D. M., & Frith, C. D. 2006. Meeting of minds: The medial frontal cortex and social cognition. *Nature Reviews Neuroscience*, 7: 268-277.
- Ashforth, B. E., & Mael, F. 1989. Social identity theory and the organization. *Academy of Management Review*, 14: 20-39.
- Ashkanasy, N. M. 2013. Neuroscience and leadership: Take care not to throw the baby out with the bathwater. *Journal of Management Inquiry*, 22: 311-313.
- Ashkanasy, N. M., Becker, W. J., & Waldman, D. A. 2014. Neuroscience and organizational behavior: Avoiding both neuro-euphoria and neuro-phobia. *Journal of Organizational Behavior*, 35: 909-919.
- Avolio, B. J., Bass, B. M., & Jung, D. I. 1999. Re-examining the components of transformational and transactional leadership using the Multifactor Leadership Questionnaire. *Journal of Occupational and Organizational Psychology*, 72: 441-462.
- Balthazard, P. A., Waldman, D. A., Thatcher, R. W., & Hannah, S. T. 2012. Differentiating transformational and non-transformational leaders on the basis of neurological imaging. *The Leadership Quarterly*, 23: 244-258.
- Bass, B. M., & Riggio, R. E. 2006. *Transformational leadership* (2nd ed.). Mahwah, NJ: Erlbaum.

- Becker, W. J., & Cropanzano, R. 2010. Organizational neuroscience: The promise and prospects of an emerging discipline. *Journal of Organizational Behavior*, 31: 1055-1059.
- Becker, W. J., Cropanzano, R., & Sanfey, A. G. 2011. Organizational neuroscience: Taking organizational theory inside the neural black box. *Journal of Management*, 37: 933-961.
- Bennett, C. M., Wolford, G. L., & Miller, M. B. 2009. The principled control of false positives in neuroimaging. *Social Cognitive and Affective Neuroscience*, 4: 417-422.
- Berridge, K. C., & Kringelbach, M. L. 2013. Neuroscience of affect: Brain mechanisms of pleasure and displeasure. *Current Opinion in Neurobiology*, 23: 294-303.
- Binder, J. R., Desai, R. H., Graves, W. W., & Conant, L. L. 2009. Where is the semantic system? A critical review and meta-analysis of 120 functional neuroimaging studies. *Cerebral Cortex*, 19: 2767-2796.
- Bono, J. E., & Ilies, R. 2006. Charisma, positive emotions and mood contagion. *The Leadership Quarterly*, 17: 317-334.
- Boyatzis, R. E., Passarelli, A. M., Koenig, K., Lowe, M., Mathew, B., Stoller, J. K., & Phillips, M. 2012. Examination of the neural substrates activated in memories of experiences with resonant and dissonant leaders. *The Leadership Quarterly*, 23: 259-272.
- Buccino, G., Binkofski, F., Fink, G. R., Fadiga, L., Fogassi, L., Gallese, V., Seitz, R. J., Zilles, K., Rizzolatti, G., & Freund, H. J. 2001. Action observation activates premotor and parietal areas in a somatotopic manner: An fMRI study. *European Journal of Neuroscience*, 13: 400-404.
- Butler, D., & Geis, F. L. 1990. Nonverbal affect responses to male and female leaders: Implications for leadership evaluations. *Journal of Personality and Social Psychology*, 58: 48-59.
- Cacioppo, J. T., & Decety, J. 2011. Social neuroscience: Challenges and opportunities in the study of complex behavior. *Annals of the New York Academy of Sciences*, 1224: 162-173.
- Conger, J. A., & Kanungo, R. N. 1988. *Charismatic leadership: The elusive factor in organizational effectiveness*. San Francisco: Jossey-Bass.
- Cropanzano, R., & Becker, W. J. 2013. The promise and peril of organizational neuroscience today and tomorrow. *Journal of Management Inquiry*, 22: 306-310.
- Darioli, A., & Mast, M. S. 2013. The role of nonverbal behavior in leadership: An integrative review. In R. E. Riggio & S. J. Tan (Eds.), *Leader interpersonal and influence skills: The soft skills of leadership: 73-100*. New York: Routledge.
- Day, D. V., Gronn, P., & Salas, E. 2006. Leadership in team-based organizations: On the threshold of a new era. *The Leadership Quarterly*, 17: 211-216.
- Denny, B. T., Kober, H., Wager, T. D., & Ochsner, K. N. 2012. A meta-analysis of functional neuroimaging studies of self- and other judgments reveals a spatial gradient for mentalizing in medial prefrontal cortex. *Journal of Cognitive Neuroscience*, 24: 1742-1752.
- Dinh, J. E., Lord, R. G., Gardner, W. L., Meuser, J. D., Liden, R. C., & Hu, J. 2014. Leadership theory and research in the new millennium: Current theoretical trends and changing perspectives. *The Leadership Quarterly*, 25: 36-62.
- Dovidio, J. F., Pearson, A. R., & Orr, P. 2008. Social psychology and neuroscience: Strange bedfellows or a healthy marriage? *Group Processes & Intergroup Relations*, 11: 247-263.
- Ellemers, N. 2012. The group self. *Science*, 336: 848-852.
- Ellemers, N., De Gilder, D., & Haslam, S. A. 2004. Motivating individuals and groups at work: A social identity perspective on leadership and group performance. *Academy of Management Review*, 29: 459-478.
- Elsbach, K. D., & Kramer, R. M. 1996. Members' responses to organizational identity threats: Encountering and countering the *Business Week* rankings. *Administrative Science Quarterly*, 41: 442-476.
- Eres, R., & Molenberghs, P. 2013. The influence of group membership on the neural correlates involved in empathy. *Frontiers in Human Neuroscience*, 7: 176. Retrieved from <http://journal.frontiersin.org/Journal/10.3389/fnhum.2013.00176/full>
- Fabbri-Destro, M., & Rizzolatti, G. 2008. Mirror neurons and mirror systems in monkeys and humans. *Physiology*, 23: 171-179.
- Falk, E. B., Berkman, E. T., Mann, T., Harrison, B., & Lieberman, M. D. 2010. Predicting persuasion-induced behavior change from the brain. *Journal of Neuroscience*, 30: 8421-8424.
- Festinger, L. 1957. *A theory of cognitive dissonance*. Evanston, IL: Row, Peterson.
- Fiske, S. T., & Taylor, S. E. 2008. *Social cognition: From brains to culture*. New York: McGraw-Hill.
- Friederici, A. D. 2011. The brain basis of language processing: From structure to function. *Physiological Reviews*, 91: 1357-1392.

- Friston, K. J., Holmes, A. P., Worsley, K. J., Poline, J. P., Frith, C. D., & Frackowiak, R. S. 1994. Statistical parametric maps in functional imaging: A general linear approach. *Human Brain Mapping*, 2: 189-210.
- Graf, M. M., Schuh, S. C., Van Quaquebeke, N., & van Dick, R. 2012. The relationship between leaders' group-oriented values and follower identification with and endorsement of leaders: The moderating role of leaders' group membership. *Journal of Business Ethics*, 106: 301-311.
- Hagoort, P., Hald, L., Bastiaansen, M., & Petersson, K. M. 2004. Integration of word meaning and world knowledge in language comprehension. *Science*, 304: 438-441.
- Hannah, S. T., Balthazard, P. A., Waldman, D. A., Jennings, P. L., & Thatcher, R. W. 2013. The psychological and neurological bases of leader self-complexity and effects on adaptive decision-making. *Journal of Applied Psychology*, 98: 393-411.
- Haslam, S. A. 2004. *Psychology in organizations* (2nd ed.). London: Sage.
- Haslam, S. A., & Platow, M. J. 2001. The link between leadership and followership: How affirming social identity translates vision into action. *Personality and Social Psychology Bulletin*, 27: 1469-1479.
- Haslam, S. A., Reicher, S. D., & Platow, M. J. 2011. *The new psychology of leadership: Identity, influence and power*. London: Psychology Press.
- Hirst, G., van Dick, R., & van Knippenberg, D. 2009. A social identity perspective on leadership and employee creativity. *Journal of Organizational Behavior*, 30: 963-982.
- Hogg, M. A., & Terry, D. J. 2001. *Social identity processes in organizational contexts*. Philadelphia, PA: Psychology Press.
- Hogg, M. A., van Knippenberg, D., & Rast, D. E. 2012. The social identity theory of leadership: Theoretical origins, research findings, and conceptual developments. *European Review of Social Psychology*, 23: 258-304.
- Howell, J. M., & Shamir, B. 2005. The role of followers in the charismatic leadership process: Relationships and their consequences. *Academy of Management Review*, 30: 96-112.
- Huettel, S. A., & Payne, J. W. 2009. Integrating neural and decision sciences: Convergence and constraints. *Journal of Marketing Research*, 46: 14-17.
- Izuma, K. 2013. The neural basis of social influence and attitude change. *Current Opinion in Neurobiology*, 23: 456-462.
- Kark, R., Shamir, B., & Chen, G. 2003. The two faces of transformational leadership: Empowerment and dependency. *Journal of Applied Psychology*, 88: 246-255.
- Kringelbach, M. L., & Rolls, E. T. 2004. The functional neuroanatomy of the human orbitofrontal cortex: Evidence from neuroimaging and neuropsychology. *Progress in Neurobiology*, 72: 341-372.
- Lee, N., Senior, C., & Butler, M. 2012. Leadership research and cognitive neuroscience: The state of this union. *The Leadership Quarterly*, 23: 213-218.
- Lieberman, M. D., Berkman, E. T., & Wager, T. D. 2009. Correlations in social neuroscience aren't voodoo: Commentary on Vul et al. 2009. *Perspectives on Psychological Science*, 4: 299-307.
- Lieberman, M. D., & Cunningham, W. A. 2009. Type I and Type II error concerns in fMRI research: Re-balancing the scale. *Social Cognitive and Affective Neuroscience*, 4: 423-428.
- Lindebaum, D. 2013. Pathologizing the healthy but ineffective: Some ethical reflections on using neuroscience in leadership research. *Journal of Management Inquiry*, 22: 295-305.
- Lindebaum, D., & Jordan, P. J. 2014. A critique on neuroscientific methodologies in organizational behavior and management studies. *Journal of Organizational Behavior*, 35: 898-908.
- McGarty, C., Haslam, S. A., Hutchinson, K. J., & Turner, J. C. 1994. The effects of salient group memberships on persuasion. *Small Group Research*, 25: 267-293.
- McLagan, P. A. 2013. A call to watch our paradigms! *Journal of Management Inquiry*, 22: 314-316.
- Molenberghs, P. 2013. The neuroscience of in-group bias. *Neuroscience & Biobehavioral Reviews*, 37: 1530-1536.
- Molenberghs, P., Bosworth, R., Nott, Z., Louis, W. R., Smith, J. R., Amiot, C. E., Vohs, K. D., & Decety, J. 2014. The influence of group membership and individual differences in psychopathy and perspective taking on neural responses when punishing and rewarding others. *Human Brain Mapping*, 35: 4989-4999.
- Molenberghs, P., Cunnington, R., & Mattingley, J. B. 2012. Brain regions with mirror properties: A meta-analysis of 125 human fMRI studies. *Neuroscience & Biobehavioral Reviews*, 36: 341-349.
- Molenberghs, P., Halász, V., Mattingley, J. B., Vanman, E., & Cunnington, R. 2012. Seeing is believing: Neural mechanisms of action perception are biased by team membership. *Human Brain Mapping*, 34: 2055-2068.
- Molenberghs, P., & Morrison, S. 2014. The role of the medial prefrontal cortex in social categorization. *Social Cognitive and Affective Neuroscience*, 9: 292-296.

- Newman, A. J., Pancheva, R., Ozawa, K., Neville, H. J., & Ullman, M. T. 2001. An event-related fMRI study of syntactic and semantic violations. *Journal of Psycholinguistic Research*, 30: 339-364.
- Nickerson, R. S. 1998. Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology*, 2: 175-220.
- Noonan, K. A., Jefferies, E., Visser, M., & Ralph, M. A. L. 2013. Going beyond inferior prefrontal involvement in semantic control: Evidence for the additional contribution of dorsal angular gyrus and posterior middle temporal cortex. *Journal of Cognitive Neuroscience*, 25: 1824-1850.
- Penny, W. D., & Holmes, A. P. 2003. Random-effects analysis. In R. S. Frackowiak, K. J. Friston, C. D. Frith, R. J. Dolan, C. J. Price, J. Ashburner, W. D. Penny, & S. Zeki (Eds.), *Human brain function* (2nd ed.): 843-850. San Diego, CA: Academic Press.
- Phillips, A. S., & Bedeian, A. G. 1994. Leader-follower exchange quality: The role of personal and interpersonal attributes. *Academy of Management Journal*, 37: 990-1001.
- Platow, M. J., van Knippenberg, D., Haslam, S. A., van Knippenberg, B., & Spears, R. 2006. A special gift we bestow on you for being representative of us: Considering leader charisma from a self-categorization perspective. *British Journal of Social Psychology*, 45: 303-320.
- Poldrack, R. A. 2006. Can cognitive processes be inferred from neuroimaging data? *Trends in Cognitive Sciences*, 10: 59-63.
- Poldrack, R. A. 2007. Region of interest analysis for fMRI. *Social Cognitive and Affective Neuroscience*, 2: 67-70.
- Price, C. J. 2012. A review and synthesis of the first 20 years of PET and fMRI studies of heard speech, spoken language and reading. *NeuroImage*, 62: 816-847.
- Reicher, S. D., Haslam, S. A., & Hopkins, N. 2005. Social identity and the dynamics of leadership: Leaders and followers as collaborative agents in the transformation of social reality. *The Leadership Quarterly*, 16: 547-568.
- Reicher, S. D., & Hopkins, N. 2001. *Self and nation: Categorization, contestation and mobilisation*. London: Sage.
- Reicher, S. D., & Hopkins, N. 2003. On the science of the art of leadership. In D. van Knippenberg & M. A. Hogg (Eds.), *Leadership and power: Identity processes in groups and organizations*: 197-209. London: Sage.
- Rogalsky, C., & Hickok, G. 2011. The role of Broca's area in sentence comprehension. *Journal of Cognitive Neuroscience*, 23: 1664-1680.
- Saxe, R. 2006. Uniquely human social cognition. *Current Opinion in Neurobiology*, 16: 235-239.
- Schurz, M., Radua, J., Aichhorn, M., Richlan, F., & Perner, J. 2014. Fractionating theory of mind: A meta-analysis of functional brain imaging studies. *Neuroscience & Biobehavioral Reviews*, 42: 9-34.
- Seyranian, V. 2014. Social identity framing communication strategies for mobilizing social change. *The Leadership Quarterly*, 25: 468-486.
- Shamir, B., House, R. J., & Arthur, M. B. 1993. The motivational effects of charismatic leadership: A self-concept based theory. *Organization Science*, 4: 577-594.
- Shondrick, S. J., Dinh, J. E., & Lord, R. G. 2010. Developments in implicit leadership theory and cognitive science: Applications to improving measurement and understanding alternatives to hierarchical leadership. *The Leadership Quarterly*, 21: 959-978.
- Sosik, J. J., Chun, J. U., & Zhu, W. 2013. Hang on to your ego: The moderating role of leader narcissism on relationships between leader charisma and follower psychological empowerment and moral identity. *Journal of Business Ethics*, 120: 65-80.
- Steffens, K. N., & Haslam, S. A. 2013. Power through "us": Leaders' use of we-referencing language predicts election victory. *PloS ONE*, 8(10): e77952. Retrieved from <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0077952>
- Steffens, N. K., Haslam, S. A., & Reicher, S. D. 2014. Up close and personal: Evidence that shared social identity is a basis for the "special" relationship that binds followers to leaders. *The Leadership Quarterly*, 25: 296-313.
- Tajfel, H., & Turner, J. C. 1979. An integrative theory of intergroup conflict. In W. Austin & S. Worchel (Eds.), *The social psychology of intergroup relations*: 33-48. Pacific Grove, CA: Brooks/Cole.
- Tesink, C. M., Petersson, K. M., Van Berkum, J. J., van den Brink, D., Buitelaar, J. K., & Hagoort, P. 2009. Unification of speaker and meaning in language comprehension: An fMRI study. *Journal of Cognitive Neuroscience*, 21: 2085-2099.
- Torta, D., & Cauda, F. 2011. Different functions in the cingulate cortex, a meta-analytic connectivity modeling study. *NeuroImage*, 56: 2157-2172.
- Turner, J. C. 1991. *Social influence*. Milton Keynes, England: Open University Press.
- Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. 1987. *Rediscovering the social group: A self-categorisation theory*. New York: Blackwell.

- Ullrich, J., Christ, O., & van Dick, R. 2009. Substitutes for procedural fairness: Prototypical leaders are endorsed whether they are fair or not. *Journal of Applied Psychology, 94*: 235-244.
- Van Bavel, J. J., Packer, D. J., & Cunningham, W. A. 2011. Modulation of the fusiform face area following minimal exposure to motivationally relevant faces: Evidence of in-group enhancement (not out-group disregard). *Journal of Cognitive Neuroscience, 23*: 3343-3354.
- Van Berkum, J. J., Holleman, B., Nieuwland, M., Otten, M., & Murre, J. 2009. Right or wrong? The brain's fast response to morally objectionable statements. *Psychological Science, 20*: 1092-1099.
- van Dijke, M., & De Cremer, D. 2010. Procedural fairness and endorsement of prototypical leaders: Leader benevolence or follower control? *Journal of Experimental Social Psychology, 46*: 85-96.
- van Knippenberg, B., & van Knippenberg, D. 2005. Leader self-sacrifice and leadership effectiveness: The moderating role of leader prototypicality. *Journal of Applied Psychology, 90*: 25-37.
- van Knippenberg, D. 2011. Embodying who we are: Leader group prototypicality and leadership effectiveness. *The Leadership Quarterly, 22*: 1078-1091.
- van Knippenberg, D., van Knippenberg, B., De Cremer, D., & Hogg, M. A. 2004. Leadership, self, and identity: A review and research agenda. *The Leadership Quarterly, 15*: 825-856.
- Van Overwalle, F. 2009. Social cognition and the brain: A meta-analysis. *Human Brain Mapping, 30*: 829-858.
- Vigneau, M., Beaucousin, V., Herve, P.-Y., Duffau, H., Crivello, F., Houde, O., Mazoyer, B., & Tzourio-Mazoyer, N. 2006. Meta-analyzing left hemisphere language areas: Phonology, semantics, and sentence processing. *NeuroImage, 30*: 1414-1432.
- Waldman, D. A. 2013. Interdisciplinary research is the key. *Frontiers in Human Neuroscience, 7*: 562. Retrieved from <http://journal.frontiersin.org/Journal/10.3389/fnhum.2013.00562/full>
- Waldman, D. A., Balthazard, P. A., & Peterson, S. J. 2011a. Leadership and neuroscience: Can we revolutionize the way that inspirational leaders are identified and developed? *Academy of Management Perspectives, 25*(1): 60-74.
- Waldman, D. A., Balthazard, P. A., & Peterson, S. J. 2011b. Social cognitive neuroscience and leadership. *The Leadership Quarterly, 22*: 1092-1106.
- Wang, X.-H. F., & Howell, J. M. 2010. Exploring the dual-level effects of transformational leadership on followers. *Journal of Applied Psychology, 95*: 1134-1144.
- Westen, D., Blagov, P. S., Harenski, K., Kiltz, C., & Hamann, S. 2006. Neural bases of motivated reasoning: An fMRI study of emotional constraints on partisan political judgment in the 2004 US presidential election. *Journal of Cognitive Neuroscience, 18*: 1947-1958.
- Wink, P. 1992. Three narcissism scales for the California Q-set. *Journal of Personality Assessment, 58*: 51-66.
- Xu, X., Zuo, X., Wang, X., & Han, S. 2009. Do you feel my pain? Racial group membership modulates empathic neural responses. *Journal of Neuroscience, 29*: 8525-8529.
- Yammarino, F. J., Salas, E., Serban, A., Shirreffs, K., & Shuffler, M. L. 2012. Collectivistic leadership approaches: Putting the "we" in leadership science and practice. *Industrial and Organizational Psychology, 5*: 382-402.