The Leadership Quarterly xxx (2022) 101656

Contents lists available at ScienceDirect

The Leadership Quarterly

journal homepage: www.elsevier.com/locate/leaqua

Registered report

The effect of charismatic leaders on followers' memory, error detection, persuasion and prosocial behavior: A cognitive science approach

Lara H. Engelbert [a,*], Michiel van Elk [b], Michal Kandrik [a], Jan Theeuwes [a], Mark van Vugt [a]

[a] Department of Experimental and Applied Psychology, VU Amsterdam, the Netherlands
[b] Institute of Psychology, Leiden University, the Netherlands

ARTICLE INFO

Keywords:
Charisma
Leadership
Followership
Information processing
Cognitive effort

ABSTRACT

Adopting a cognitive and follower-centric approach to charismatic leadership, we hypothesized that followers show lower levels of cognitive effort, reflected in superficial processing of factually correct information when listening to and viewing a charismatic leader. We conducted two experiments, using a 2 (*charismatic versus neutral*) × 2 (*female versus male leader*) between-subjects design and videos of trained actors delivering a speech. We examined the effects of leader charisma on (1a) followers' ability to detect factually false information, (1b) accuracy to remember information from the leader (study 1, $N = 100$), (2a) the persuasiveness of factual messages, (2b) followers' prosocial behavior and (2c) the mediating effect of the leader's persuasiveness on followers' prosocial behavior (study 2, $N = 140$). We did not find support for the effect of leader charisma on detecting false information, the persuasiveness of messages, or increased prosocial behavior among followers. We found an effect of leader charisma on memory. Participants recognized fewer messages in the charismatic compared to the neutral leader conditions. Exploratory analyses provided mixed results for an interaction effect of leader charisma and sex on detecting and remembering false information. Our studies offer first insights into the cognitive outcomes of the charismatic signaling process.

Throughout history the power of charismatic leaders has been documented by writers who frequently attributed charisma to a mysterious capability only possessed by a handful of individuals with outstanding personal qualities (Antonakis et al., 2016; Weber, 1968). Charismatic leaders such as Jesus, Martin Luther King Jr. and Gandhi were often admired for their astonishing and inexplicable persuasive powers, which facilitated the attraction, coordination, and cooperation among followers (van Vugt & Smith, 2019). Charisma is also attributed to prestigious leaders in traditional societies, such as medicine-men and shamans who are important, authoritative figures within their communities, enjoying almost absolute obedience from their followers (Petaros et al., 2015). Charismatic leadership remains a powerful leadership type. However, despite its omnipresence, the cognitive mechanisms that can potentially explain the influence of charismatic leaders on their followers remain unexplored.

We begin with an overview of charismatic leadership research and focus on an evolutionary leadership approach. We highlight the gaps in the current literature and explain the necessity of a follower-centric perspective. Then, we introduce cognitive science theories to address the influence of leader charisma on followers' cognitive information processes and their outcomes. Next, we outline our *minimal cognitive effort hypothesis* which explains how charismatic leaders might facilitate superficial cognitive processing of factually correct or incorrect information in followers. We further explain how charisma not only affects followers' cognitive processes, but also guides followers' behavior by promoting prosocial actions. Finally, we outline our experimental approach to test our predictions on how charismatic leadership affects cognitive information processes in followers.

Evolutionary leadership theory

From an evolutionary perspective, leadership is an adaptive social mechanism aimed at coordinating and mobilizing group members in response to a particular threat or opportunity in the environment, such as collective defense or access to food. Effective leaders are able to recruit and motivate followers for collective action (Bastardoz & van Vugt, 2019; Grabo et al., 2017). Yet, following a leader requires giving up autonomy to the leader, and is therefore potentially costly.

Peer review under responsibility of Footnote should NOT be denoted as star next to the title. It should be at the bottom of the page.

* Corresponding author.
E-mail address: l.h.engelbert@vu.nl (L.H. Engelbert).

https://doi.org/10.1016/j.leaqua.2022.101656
Received 22 July 2019; Revised 26 September 2022; Accepted 8 October 2022
Available online xxxx
1048-9843/

According to evolutionary leadership theory, humans possess an adaptive followership psychology. This enables them to assess situations in which it is profitable to follow particular individuals and assess their leadership potential by relying on certain cues that are indicative of good leadership (for example, competence, trustworthiness, vision; Laustsen & Petersen, 2015; van Vugt et al., 2008). Charisma is best viewed as a generic signal, or cue, indicative of an individual's qualities to attract and mobilize a group of followers for joint action through appealing to their emotions, identities and values (Antonakis et al., 2016; Grabo et al., 2017). In return, charismatic leaders receive status benefits in the form of prestige and access to resources (Hollander, 1992; Price & van Vugt, 2014).

Charismatic leadership constitutes a unique process of social influence and can have extraordinary effects on followers (Antonakis et al., 2016; House, 1977). Unsurprisingly, the charisma concept has been extensively discussed and investigated across many different leadership fields. Yet, for leadership scholars the construct of charisma has remained difficult to define. For example, charisma is often confused with transformational and visionary leadership, or defined by its outcomes (van Knippenberg & Sitkin, 2013). Recent attempts have redefined and clarified the construct of charisma as a signaling process by which leaders attempt to influence followers through the expression of emotions, values and symbols (Antonakis et al., 2016; Grabo et al., 2017). In the present study, we consider charisma to be a signal of leaders' outstanding personal qualities that enables them to attract, mobilize and coordinate followers for a shared cause (van Vugt & Smith, 2019).

State of charismatic leadership research

Reviewing the literature on charismatic leadership reveals several gaps that we aim to fill with our proposed studies. First, charisma research has mainly focused on the role of the leader while neglecting the importance of adopting the follower perspective (Bastardoz & van Vugt, 2019). When the role of followers is considered in past research, it mainly concerns perceptions of the leader via explicit self-report measures that are prone to different types of socio-cognitive biases (Antonakis et al., 2016). Second, research on charismatic leadership tactics identified core verbal and non-verbal signaling strategies as crucial elements underlying the influence of a charismatic leader, for example, using rhetoric, sharing sentiments with followers, demonstrating passion and the use of facial expressions (Antonakis et al., 2011). Thus, there is a need to pay more attention to followers and explore the cognitive aspects of leaders' charismatic influence. Third, while research on charismatic leadership has grown over the past decades, the field has underutilized experimental designs that have the potential to establish causality (Podsakoff & Podsakoff, 2019). During the time of writing and conducting this registered report, several studies have objectively manipulated charisma and explored real follower outcomes (Antonakis et al., 2021; Ernst et al., 2021; Fest et al., 2021; Meslec et al., 2020). We pursue this line of research and apply a similar experimental approach to examine the cognitive outcomes of the charismatic signaling process in our registered report studies.

Traditionally, charisma research has utilized cross-sectional or case study designs that are suboptimal from a methodological viewpoint (see Shamir et al., 1994; Tosi et al., 2004; Vlachos et al., 2013). When experimental designs are being employed, the content and delivery of a message has often been used to manipulate charisma (see Awamleh & Gardner, 1999; den Hartog & Verburg, 1997; Holladay & Coombs, 1993; Howell & Frost, 1989; Kirkpatrick & Locke, 1996; Shamir et al., 1994). These manipulations are subject to multiple potential confounds, because the leaders' messages differ along various dimensions, such as the emotional value of the message that might induce short-term affection in the participants (Awamleh & Gardner, 1999; den Hartog & Verburg, 1997). In the present study, we controlled for the influence of the emotional value of information by assessing followers' processing of factually correct but emotionally neutral information delivered in a charismatic speech. Finally, researchers sometimes deployed actors or trained speakers to act as charismatic leaders (Holladay & Coombs, 1993; Howell & Frost, 1989; Kirkpatrick & Locke, 1996). The problem here is that participants often have no real connection with these leaders because a shared goal or vision is missing (e.g., climate change activism), making it difficult to activate genuine follower emotions and cognitions, and often prevent that followers' identify with the leader's vision. Our proposed studies add to the literature by creating a realistic and relevant leader–follower setting by selecting a leader context that is relevant to the follower (i.e., climate change and sustainability), using charismatic leadership tactics performed by trained actors to manipulate charisma (Antonakis et al., 2021; Meslec et al., 2020) and utilizing cognitive tasks to examine the influence of charismatic leaders on followers' cognitive information processing outcomes.

Adopting a follower-centric approach

Charisma is prestige-based signaling and leaders receive status benefits for the potential risks they run in leading a group (Antonakis et al., 2016; Grabo et al., 2017; Hollander, 1992; Price & van Vugt, 2014). Perceived leadership qualities such as being generous, inspiring, and visionary increase the odds that a leader is seen as charismatic (Hollander, 1992; Williams et al., 2018). Charismatic leaders rely on this emotional, value-based and symbolic signaling path to exercise influence and persuasiveness, and gain voluntary followers (Antonakis et al., 2016; Grabo et al., 2017). Thus, the charisma of the leader manifests itself in the way the leader acts, behaves and speaks. Several charismatic leadership tactics have been identified, for example, using metaphors and contrasts, and displaying facial expressions or using hand gestures (Antonakis et al., 2011). By applying these verbal and non-verbal techniques, these leaders are able to convincingly signal their vision and values, and influence followers' information processes. But in order to understand this influence we need to shift the lens from a leader-centric to a follower-centric perspective. Remarkably, the importance of followers' cognitive information processes was already noted in the 70s and continued to be addressed by scientists throughout the last two decades (Emrich, 1999; Hall & Lord, 1995; House, 1977; Lord & Emrich, 2000; Rock & Schwartz, 2006). In addition, there is considerable consensus among scholars that charismatic leadership has profound effects on followers' cognition (Ensari & Murphy, 2003; Hall & Lord, 1995; Shamir et al., 1993). Leadership stereotyping, role models and leader characteristics affect followers' memory systems, influencing how information from leaders is being processed (Emrich, 1999; Hall & Lord, 1995).

A cognitive science perspective

Researchers have made efforts to theoretically link the effects of charisma to followers' cognition (Emrich et al., 2001; Lord & Emrich, 2000; Shamir et al., 1993). Yet, so far no study has assessed followers' cognitive processes – such as attention and memory – when processing information from a charismatic leader, and causal evidence for the effects of charisma on cognition is lacking.

We propose to fill this gap by adding cognitive science methods to charisma research. Especially, we suggest that a leader's charisma will affect followers' cognitive information processing by modulating the perception and processing of language-based information in a top-down manner. Indeed, many studies from the field of expectancy effects and hypnosis highlight the powerful influence of top-down mechanisms on information processing (Clark, 2013; Crum & Phillips, 2015; Engel et al., 2001; Stewart-Williams & Podd, 2004). Similar to the effect of expectations on information processing, we sug-

gest that leader charisma offers cognitive heuristics for processing messages from the leader (Reh et al., 2017; Sperber, 2010). Especially, the follower perceives the charismatic leader as a role-model who provides valuable, consistent and accurate information and therefore, it is not necessary to elaborate on or evaluate the correctness or relevance of information provided by the leader (cf. prestige-bias; Cheng, 2020; Henrich et al., 2015).

The minimal cognitive effort hypothesis

In the present study, we argue that leader charisma affects followers' cognitive information processes, resulting in *minimal cognitive effort* invested by followers when processing arguments from the leader. We argue that the leader's charisma activates cognitive heuristics to process information. These determine top-down processing of sensory (language-based) information, leading to more superficial cognitive processing. Current theories from cognitive and evolutionary science support our hypothesis.

First, evolutionary approaches delineate that leader–follower relations are formed when individuals give up their autonomy, structurally or temporarily, to defer to the leader (Bastardoz & van Vugt, 2019). This implies that in contexts in which people are uncertain what to do, rather than spending energy on finding solutions themselves via individual trial-and-error learning, they rely on leaders for guidance. Thus, followership is a way to conserve cognitive energy as it enables people to spend minimal cognitive and physical effort to achieve their goals (van Vugt, 2006).

Second, charismatic leaders often act as prestigious role-models and their authority is used as a substitute for the costly processing of new information by followers themselves (Henrich et al., 2015). We thus argue that leader charisma influences perceptions of the quality of information provided by the leader. Especially, the specific verbal and non-verbal techniques that charismatic leaders use to influence their followers add to their persuasiveness (Antonakis et al., 2011). These tactics affect how followers process information provided by the leader. People rely on the charismatic leadership cues as a heuristic that the information presented is reliable, trustworthy and important. As a consequence, followers may be less likely to engage in an extensive, elaborative and critical cognitive analysis of the information that is presented, as it was already deemed to be important and correct. The result of which is that followers will pay less attention to the actual content of the information from the leader and will be less able to memorize exactly what the leader said.

Third, the predicted *minimal cognitive effort* is also consistent with research on source credibility. Credibility and competence are core values of leadership (Posner & Kouzes, 1988). Sperber (2010) argues that when followers perceive a leader as credible and authoritative, they are more likely to accept ambiguous and complex information without critical reflection. This so-called "guru-effect" can explain how leader charisma serves as an external reason for endorsing arguments made by the leader even if followers do not fully comprehend the leader's argumentation.

A fourth line of evidence providing support for the *minimal cognitive effort* hypothesis is provided by a brain imaging study. When religious followers were listening to prayers from a charismatic leader – a Christian leader with healing powers – followers showed a reduction in prefrontal brain networks, regions associated with executive and social cognitive functioning (Schjoedt et al., 2011). In addition, the cognitive resource depletion model explains how charismatic authorities decrease individuals' cognitive effort in a religious context, preventing followers from memorizing details of the leader–follower interaction (Schjoedt et al., 2013). Although these results have to be interpreted with caution regarding methodological and contextual effects, they illustrate how followers might invest only *minimal cognitive effort* in interactions with a charismatic leader.

Behavioral effects of charisma

Besides the hypothesized effect of leader charisma on followers' cognitive information processing outcomes, there are also indications for behavioral effects following exposure to a charismatic leader. Such leaders motivate their followers to cooperate and contribute to a collective goal (Antonakis et al., 2016; Cheng, 2020). They act as role-models, showing kind, prosocial and generous behavior, which increases the odds that followers will imitate such behavior (Kafashan et al., 2014). For example, participants donated greater amounts of money in a trust game after being exposed to a charismatic speaker (cf. charisma prosociality hypothesis; Grabo & van Vugt, 2016). Moreover, articulating a vision increases the likelihood that followers will make short-term sacrifices to help the collective (Joireman et al., 2006). In addition, due to *minimal cognitive effort* when processing information from a charismatic leader, followers may not scrutinize the reasons behind the leader's argumentation. Consequently, followers would not only be more persuaded by the leader's statements but also comply more with requests from the leader, for example, to make sacrifices to support a collective purpose such as donating time or money.

Integrating cognitive science methods into leadership research

In the present study, we examined if leader charisma causes *minimal cognitive effort* invested by followers when processing information from the leader. Cognitive (neuro)science offers promising tools to examine cognitive information processes in leader–follower interactions (Boyatzis, 2011; Waldman et al., 2011). We are mindful that simplifying leader–follower interactions in this way potentially threatens the ecological validity of the research (Lindebaum & Zundel, 2013). However, creating experimental rigor allows us to draw causal inferences and this is what has been generally lacking in the literature on charismatic leadership (Podsakoff & Podsakoff, 2019).

There are different paradigms available in cognitive science to operationalize and assess cognitive effort effects of charismatic leadership on followers. We operationalize cognitive information processing outcomes and subsequent behavior, by assessing (1a) participants' ability to detect factually false information, (1b) accurately remember previously presented emotionally neutral information from a charismatic leader in study 1, and (2a) whether participants are persuaded by emotionally neutral information, (2b) accordingly show prosocial behavior and (2c) whether the leader's persuasiveness mediates the effect of charisma on prosocial behavior in study 2.

First, the ability to detect or monitor false information is a crucial element of information processing (Gehring et al., 1993). Thus, superficial cognitive processing of information that originates from the charismatic leader will decrease the odds that followers detect false information, because they do not pay attention to the factual correctness of a message and they expect to obtain valuable and correct information from a highly prestigious leader (1a; prestige-bias; Cheng, 2020; Henrich et al., 2015).

Second, remembering information is a fundamental ability that relies on how the previous information was processed (Cowan, 1988). Therefore, minimal cognitive engagement increases the odds that followers will not memorize informational details, because information was processed superficially with minimal attention to, for instance, details of the message (1b; Schjoedt et al., 2013).

Third, we captured the persuasive mechanisms of charismatic leaders in two ways – using cognitive and behavioral methods. Because charismatic leaders are trusted, competent authorities, followers might be easily persuaded by the information they provide (Cheng, 2020; Sperber, 2010). Thus, the awareness of the leader's charisma influences how information originating from this leader is processed (2a).

At the same time, the charismatic leader increases the followers' willingness to cooperate and contribute to a shared goal, for

example, by sharing group sentiments and providing a vision (Antonakis et al., 2011). Thus, followers should act according to the leader's persuasiveness and show more prosocial actions (2b). In turn, the leader's persuasiveness might mediate the effect of leader charisma on prosocial behavior. First, minimal cognitive processing of information from the leader increases the odds that followers are more easily persuaded by arguments. Second, if followers pay superficial attention to a leader's argumentation – for example, why they should donate to a charity – the follower might be more likely to comply with this request because they are already persuaded by the arguments (2c). Then, minimal cognitive processing of factual information potentially facilitates prosocial actions requested by the leader.

Present research: design and hypotheses

Charismatic leaders usually operate within a specific real-world context, for example, in religion, politics, or businesses in which they share certain values and a vision with their followers (Awamleh & Gardner, 1999; Conger & Kanungo, 1987; Conger et al., 2000; Shamir et al., 1998). Therefore, we took the following steps in designing the current set of studies to increase the ecological validity. First, we carefully considered the context in which our experimental designs are implemented. To foster the engagement of the participants with the leader and tasks, we chose the theme of environmental activism against climate change as the context for the experiments. Second, we used environmental and emotionally neutral facts as information provided by the leader to enhance the external validity of our experiments and reduce potential confounds. Third, we recorded a female and male actor for our charisma manipulation to increase the ecological validity and generalizability of our findings.

Charisma is sometimes associated with a female leadership style and research has shown that female leaders regard charismatic and value-based guiding as more important than male leaders (cf. feminine leadership advantage; Paris et al., 2009). However, in some studies men have been ascribed higher charisma than women (Jokisch et al., 2018). Moreover, female leaders who were judged as equally charismatic as male leaders were found to show greater effort by using more acoustic charismatic cues than male leaders (Novák-Tót et al., 2017). Other researchers state that charisma is such a powerful leadership style that it outweighs the influence of the leader's sex (Johnson et al., 2008). Thus, there is inconclusive evidence for a directional interaction effect of the leader's sex and charisma. We therefore did not have specific predictions concerning an effect of the leader's sex on followers' cognitive and behavioral outcomes.

In this registered report, we conducted two experimental studies which share certain methodological characteristics but examine distinct cognitive or behavioral processes: (1a) detecting factually false information, (1b) remembering emotionally neutral information provided by the leader, (2a) being persuaded by factual propositions made by the leader, (2b) accordingly showing prosocial behavior by donating for a collective purpose and (2c) a mediation effect of the leader's persuasiveness on the effect of charisma on prosocial behavior. The manipulation of charismatic leadership consisted of a video in which a trained, native-English speaking actor (*female versus male*) delivers a speech by using charismatic leadership tactics (*charismatic versus neutral*). After watching one of the videos, participants completed the cognitive or behavioral tasks depending on the study.

Study 1

First, we assessed participants' ability to detect false information and remember statements made by the leader during the speech.

Hypothesis 1a. *We expected that participants detect fewer errors (false statements) presented in the charismatic condition as compared to participants in the neutral condition.*

Hypothesis 1b. *We predicted that participants remember fewer factual statements in the charismatic condition as compared to participants in the neutral condition.*

Study 2

Second, we assessed the persuasive influence of a charismatic leader by asking participants whether they are persuaded by a number of different factual statements made by the leader during the speech. We also assessed whether participants are more likely to comply with a request from the charismatic leader and accordingly show prosocial behavior following the leader's messages.

Hypothesis 2a. *We predicted that participants are more persuaded by information from the leader in the charismatic condition as compared to the neutral condition.*

Hypothesis 2b. *We expected that participants donate a greater share of their experimental earnings to an environmental organization in the charismatic condition as compared to the neutral condition.*

Hypothesis 2c. *We expected that the leader's persuasiveness mediates the effect of charisma on donations followers make to an environmental organization.*

Method study 1

Ethics

The proposed studies have been approved by the institutional Local Research Ethics Committee (VCWE) from the VU University Amsterdam. Participants were at least 18 years old and gave informed consent before they participated in the studies. They had the right to withdraw from participation at any time during the studies without repercussions. In line with the university's ethical guidelines, after participating in the study, participants received a written debriefing and the contact details of the study investigator. Participants had the opportunity to ask questions after the experimental session and were instructed to not share the information with other future participants. Participants enrolled independently from each other in the experiment which further reduced the chances of spill-over effects.

Design

We used a between-subjects repeated measures design with the two independent variables leader charisma (*charismatic versus neutral*) and leader sex (*female versus male*). Participants were randomly assigned to one of the four conditions: charismatic female, neutral female, charismatic male, or neutral male. The study was conducted online, while participants attended a video call with the experimenter.

Participants

For both studies, we recruited participants using online flyers distributed via university channels, the university participant recruitment system SONA and announcements on internal university course pages. Participants were invited to register for a study on assessing attitudes

about climate change and sustainability. They received EUR 8 for their participation.

Materials

Charisma manipulation

For our experimental manipulation, we wrote two speeches on the topic of climate change and sustainability. Both speeches have a similar amount of words and contain the same (emotionally neutral) statements used in the cognitive tasks. We recorded two professional native-English speaking actors (*female and male*) who delivered the speeches (*charismatic versus neutral*). The speeches differ on non-verbal charismatic leadership tactics (CLTs) that are signaled by the respective actor (facial expressions, gestures, animated tone of voice) and verbal tactics that are included in the speech content, such as lists, stories, rhetorical questions and sentiments to the collective (Antonakis et al., 2021). The speeches contain three different types of information. First, to assess the effect of leader charisma on error detection, we implemented four factually false statements in the speeches. Second, to assess the effect of leader charisma on participants' ability to remember factual information, we implemented 15 factually correct and emotionally neutral statements. Third, the speeches contain additional information used to manipulate charisma in line with the verbal CLTs (Antonakis et al., 2011). These tactics draw on various emotional and verbal communications skills. However, research has shown that cognitive processes can be influenced by the emotional valence of stimuli (Cahill & McGaugh, 1995). Therefore, we conducted a pilot study (supplementary material B) to examine valence and arousal ratings of the statements that are part of both the speech and the cognitive tasks to control for a possible effect of the emotional valence of the statements on followers' cognitive processes.

Manipulation checks

Pre-test objective manipulation check. Two trained observers independently coded the written speeches on the absolute absence or presence of the nine verbal and three non-verbal CLTs, and the presence of incorrect statements, according to the method used by Antonakis et al. (2021). The observers rated each sentence of the speech on the presence and absence of the verbal CLTs and factually false statements, and counted the number of total instances of non-verbal tactics during each video. The coders agreed on 98% of the 880 coding events for the neutral and 92% of the 920 coding events for the charismatic speech. However, we only found weak interrater reliability for the neutral ($\kappa = 0.30$, $z = 8.85$, $p < .001$) and charismatic ($\kappa = 0.30$, $z = 9.03$, $p < .001$) speech. The independent coders reported to initially have had different interpretations of some of the CLTs (contrasts, sentiments to the collective etc.). Accordingly, when testing for inter-coder reliability on the total absence or presence of CLTs per sentence irrespective of the specific tactic used, the inter-coder reliability increased (neutral speech: $\kappa = 0.52$, $z = 5.04$, $p < .001$; charismatic speech: $\kappa = 0.45$, $z = 4.32$, $p < .001$). The coders reconciled the differences until they reached agreement (supplementary material C). The final number of CLTs identified by the coders in the neutral speech as proportion of total sentences was 13.6% (12 CLTs over 88 sentences) as opposed to a proportion of 63.04% (58 CLTS over 92 sentences) in the charismatic speech. The independent coders detected all factually incorrect statements in the neutral and charismatic speech. The proportions of CLTs used in the neutral (12 / 88) and charismatic speech (58 / 92) were significantly different, χ^2 (1) = 44.14, $p < .001$. The number of gestures and facial expressions (charismatic female: 188; charismatic male: 176; neutral female: 30; neutral male: 25) was statistically significantly associated with the condition of the speech, (χ^2 (3) = 43.34, $p < .001$).

Pre-test subjective manipulation check. For study 1 and 2, we conducted one pilot study to obtain subjective ratings for the perceived charisma of the leaders. We recruited 120 participants and randomly assigned each participant to one of the eight videos for study 1 or 2. First, participants gave informed consent and answered demographical questions. After completing a video sound check, participants were randomly assigned to one of the eight videos. After watching and rating the leader, participants answered an attention check question (selecting the name of the leader from two options), and specified any technical problems they experienced. Fourteen participants did not complete the study.

Fifty-two participants rated one of the four videos for study 1 on five items assessing the charisma of the speaker (Grabo & van Vugt, 2016; "*charismatic*", "*likable*", "*enthusiastic*", "*inspiring*", "*warm*"; Cronbach's $\alpha = 0.74$). Two of the participants indicated to not believe in climate change. We excluded these participants from the analysis because of the importance of environmentalism to the leader–follower scenario in the study. Two participants did not pass the sound check and failed the attention check or had technical problems and failed the attention check. We excluded these participants from the subsequent analysis. We analyzed the data of the remaining 48 participants (female = 39; $M_{age} = 20.56$; $SD = 1.92$). We calculated a composite score for charisma by averaging all ratings for the five items per participant (Table 1). We fitted a multiple regression model to predict the charisma composite score based on the leader charisma and leader sex conditions. The overall regression was not statistically significant (adjusted $R^2 = 0.09$, $F(3, 44) = 2.63$, $p = .062$). There was no significant interaction effect of leader charisma and leader sex on charisma ratings ($B = 0.37$, $se = 0.37$, $p = .322$). When excluding the interaction effect from the model, the overall regression equation was significant (adjusted $R^2 = 0.09$, $F(2, 45) = 3.44$, $p = .041$). The leader charisma condition significantly predicted charismatic ratings ($B = 0.45$, $se = 0.18$, $p = .018$, partial $\eta^2 = 0.12$). Leader sex did not have a significant effect on charisma ratings ($B = -0.15$, $se = 0.18$, $p = .422$). The leaders in the charismatic condition ($M = 4.09$, $SD = 0.50$) were rated significantly more charismatic than the leaders in the neutral condition ($M = 3.63$, $SD = 0.73$).The results of our subjective manipulation check are similar to results obtained by Meslec et al. (2020), who found a significant effect of leader charisma (manipulated with CLTs) in their subjective manipulation checks using the vision dimension of the Transformation Leadership Inventory (Podsakoff et al., 1990; $M_{charisma} = 2.74$, $M_{neutral} = 2.28$, $\eta^2 = 0.09$). Additionally, we note that extracts of the same videos were used in other experimental studies and tested accordingly in separate validation studies, supporting the difference in perceived charisma between the charismatic and neutral condition in a different independent sample (supplementary material F).

Dependent measures

Error detection task

Pre-test statement selection. We recruited 56 participants (university recruitment system SONA, female = 50, $M_{age} = 20.04$, $SD = 2.24$) and randomly assigned them to one of two data sets ($N = 28$ per data set). Each of the data sets contained 17 statements of a previously emotionally neutral rated statement set, for which we created one incorrect statement for each original, factually correct version (supplementary material B). Participants read 10 unique cor-

Table 1
Means and Standard Deviations Charisma Ratings Pre-Test Study 1.

Condition	*n*	*M*	*SD*
Charismatic female	12	4.07	0.26
Charismatic male	11	4.11	0.69
Neutral female	12	3.80	0.66
Neutral male	13	3.48	0.78

Note. Charisma ratings for each video were obtained in a separate pilot study, independent of the experimental study.

rect and seven unique incorrect statements, or vice versa. We asked participants to identify per statement whether it is factually correct or incorrect. We presented an example to the participants (*"Apples grow on trees." is a factually correct statement, whereas "Apples grow underground." is a factually incorrect statement*). We also asked participants how certain they were about their response (1 = *Very uncertain,* 5 = *Very certain*). We calculated the percentage of participants who correctly categorized the statement as factually correct or incorrect per statement. We selected four statements for the speeches, and their matching correct versions (Table 2), that were identified as factually incorrect (or correct respectively) by at least 75% of the participants ($M_{\text{Valence}} = 4.31$, $SD = 1.50$, $M_{\text{Arousal}} = 4.11$, $SD = 1.30$).

Task. In study 1, we used an adaptation of the Conflict Verification Task (CVT; Stadtler et al., 2013) to measure participants' ability to detect factually false information presented by the leader. In short, noticing that the leader presents false information requires that 1) participants remember that the information was presented, and 2) identify the information as false. The task contained eight statements (composed of four statement pairs; Table 2). The four factually incorrect statements were presented during the speech. The four factually correct distractor statements were not presented in the speech, and only differ from the false statements on one key word. During the error detection task, participants saw the two statements of one statement pair simultaneously. The pairs were presented in randomized order. First, we asked participants to read each statement of the pair and select in a forced-choice format the one that was presented by the leader in the speech. The selected statement appeared on the screen again and participants indicated in a forced-choice manner whether the statement was factually correct or incorrect. By asking both questions, we aimed to rule out that participants scored high on the identification of false information despite not remembering that the leader made this statement. By including highly similar distractor statements we further aimed to prevent a ceiling effect of identifying the statements as being presented in the speech or being factually false due to context information in the statement itself. Participants received one score per statement pair based on the two-stage composite of the responses to both questions per pair. Participants only received a score of 1 (= *Detected*) if both questions were answered correctly, i.e., 1) participants identified correctly that the statement was presented by the leader and 2) that the information was factually incorrect. We coded all other response patterns with a score of 0 (= *Not detected*). The results of the error detection task were analyzed at the statement pair level.

Memory task

Pre-test statement selection. To assess participants' recognition for factual information that was presented by the leader, we selected 15 statement pairs (30 statements) from the emotionally neutrally rated pilot statement set ($M_{\text{Valence}} = 3.97$, $SD = 1.11$, $M_{\text{Arousal}} = 4.12$, $SD = 0.95$). Fifteen of these statements are implemented in the speech (signal items), the other 15 statements served as distractors (noise items) in the memory task (Table 3). The signal and noise items of each statement pair have a similar syntax, number of words and content.

Table 2
Statements Error Detection Task Study 1.

Factually incorrect statement	Factually correct statement
Air pollution defines a cleansing substance that is present in the air.	Air pollution defines a pollutant substance that is present in the air.
Weather cannot change from hour to hour, day to day and season to season.	Weather can change from hour to hour, day to day and season to season.
Global warming describes decreases in worldwide surface temperatures.	Global warming describes increases in worldwide surface temperatures.
Fossil fuels include oil, coal and wind.	Fossil fuels include oil, coal, and gas.

Note. For each row, the incorrect and correct statement form one statement pair.

Table 3
Example Statements Memory Task Study 1.

Signal statement	Noise statement
Global warming commonly refers to the observed warming since pre-industrial times.	Global warming defines a long-term rise in the temperature of the earth's climate.
Carbon dioxide (CO2) traps solar radiation in the atmosphere.	Carbon dioxide (CO2) is a long-lived greenhouse gas in the atmosphere.
Solar radiation passes through the earth's atmosphere.	Solar radiation has shorter wavelengths than infrared radiation.

Note. Signal items were part of the speech and shown during the memory task. Noise items were only shown during the memory task.

Task. Participants were presented with all 30 factually correct and emotionally neutral signal and noise statements. Fifteen of these statements were from the speech (signal items), 15 were not present in the speech (noise items) but highly similar to the presented statements and served as distractor items. The statements were presented in a randomized order, one statement at a time, to assess participants' memory for information that was presented by the leader. One statement at a time was shown to the participant. For each single statement, we asked participants whether the information was presented by the leader during the speech ("*Yes*", "*No*"). Per statement, we coded correct answers 1 (Hits and Correct Rejections) and incorrect answers 0 (Misses and False Alarms). The results of the memory task were analyzed at the single statement level.

Covariates

To assess and control for the extent to which participants were engaged with the environment, we asked participants how concerned they are with the environment (1 = *Not at all concerned*, 5 = *Very concerned*). We added this variable as a covariate to the statistical models in our analysis. In addition, we added the participant's sex as a covariate as the perceptions of female and male leaders might differ between female and male participants.

Procedure

Due to COVID-19 restrictions, participants completed the study online, while attending a video call with the experimenter to ensure that participants completed the study in one session. One participant was tested at a time. The experimenter informed participants that they would view a speech about climate change and sustainability, and would answer some questions afterwards. After giving informed consent, the experimenter and participant switched off their camera and microphone. Next, participants answered the demographical questions (age, sex, environmental concern, belief in climate change) and completed a video and sound check by watching a short video in which they were instructed to select the option "*Strongly agree*" on a response scale. Participants were randomly assigned to one of the four leader conditions and watched the respective video speech. Subsequently, participants answered an attention check question (selecting the name of the leader) and were asked whether they had any technical problems while viewing the video. Participants continued with completing the error detection and memory task. Finally, they received a written debriefing and switched on their camera and microphone again. The experimenter asked them whether they had been interrupted or experienced any technical issues during the study. The experimenter noted any deviations, additional comments or questions that participants had.

Results study 1

We performed all statistical analyses in R (R Core Team, 2022). The data was collected in March and April 2021. Means, standard deviations and correlations of all variables are shown in Table 4.

Sample

For study 1, we recruited 100 participants (female = 76, M_{age} = 23.84, *SD* = 5.30, sample size calculation supplementary material A). Thirty-nine percent of the participants indicated to be very concerned with the environment (5-point Likert scale from (1) *Not at all* to (5) *Very concerned*; 46% = 4; 13% = 3; 2% = 2). Except one participant who selected "*Don't know*", all participants indicated to believe in climate change. Sixty-four percent of the participants indicated excellent, 30% good and 6% average English language proficiency.

Error detection

The results of the mixed model analyses are presented in Table 6 with Model 1 reporting the main effects of the manipulations, Model 2 reporting the manipulation effects while controlling for environmental concern and participant sex, Model 3 including the manipulation effects and their interaction term and Model 4 reporting the manipulation effects, their interaction term and the control variables. In contrast to our hypothesis (1a), the charisma condition had no significant effect on error detection (Model 1 B = -0.10, OR = 0.91, p = .734; Model 2 B = -0.05, OR = 0.95, p = .868; Model 3 B = -0.72, OR = 0.49, p = .071; Model 4 B = -0.67, OR = 0.51, p = .092). The male leader condition had no effect on error detection in the models without the interaction terms (Model 1 B = -0.17, OR = 0.85, p = .564; Model 2 B = -0.18, OR = 0.84, p = .539). However, we found an unpredicted statistically significant interaction effect of the charismatic and male leader condition (Model 3 B = 1.27, OR = 3.55, p = .027, Model 4 B = 1.26, OR = 3.52, p = .027). On average, participants identified 28% of the factually incorrect statements in the female and 37% in the male charismatic leader condition, and 42% in the female and 27% in the male neutral leader condition (Table 5). However, the follow-up pairwise comparisons using a Tukey post-hoc test corrected with Holm's sequential Bonferroni procedure showed no significant contrasts. The models that include the interaction term showed a significant effect of the male leader condition on error detection (Model 3 B = -0.79, OR = 0.45, p = .049; Model 4 B = -0.80, OR = 0.45, p = .046). Participants identified fewer factually incorrect statements in the male (32%) than in the female leader condition (35%).

Bayes factor

To quantify the evidence for the null hypothesis that there is no main effect of leader charisma on error detection and reliably estimate Bayes factors, we fitted the data to Bayesian models using the 'brms' package. We regressed participants' detection of erroneous information per item pair (0 = *Not detected*, 1 = *Detected*) on the sex of the leader and the covariates environmental concern and participant sex, and the random intercepts per participant and item pair. We compared this model to the full model which includes a main effect of charisma. The model comparison indicated anecdotal evidence for the null-hypothesis (BF_{01} = 1.49). These results suggest that participants did not detect less erroneous information in the charismatic compared to the neutral leader condition. However, a Bayes Factor between 1 and 3 only provides weak, and therefore, insufficient evidence (van Doorn et al., 2021).

Memory

The results of the mixed models analyses are shown in Table 7 with Model 1 reporting the main effects of the manipulations, Model 2 reporting the main effects while controlling for environmental concern and participant sex, Model 3 including the main effects and their interaction term and Model 4 reporting the main effects, their interaction term and the control variables. Participants correctly categorized 60% of the statements in the female and 63% in the male charismatic leader condition, and 67% in the female and 65% in the male neutral leader condition (Table 5). In line with our hypothesis, the charisma condition had a significant effect on memory (Model 1 B = -0.20, OR = 0.82, p = .036; Model 2 B = -0.19, OR = 0.83, p = .050; Model 3 B = -0.34, OR = 0.71, p = .012; Model 4 B = -0.31, OR = 0.73, p = .020). Participants recognized fewer factual statements presented in the charismatic conditions (62%) as compared to participants in the neutral leader conditions (66%). There was no significant interaction effect of the charismatic and male leader condition on memory (Model 3 B = 0.27, OR = 1.31, p = .149; Model 4 B = 0.25, OR = 1.28, p = .185). The male leader condition had no significant effect on memory (Model 1 B = 0.02, OR = 1.02, p = .800; Model 2 B = 0.03, OR = 1.03, p = .764; Model 3 B = -0.11, OR = 0.89, p = .397; Model 4 B = -0.10, OR = 0.91, p = .463).

Exploratory analyses

Test of balance

Participants were randomly assigned to conditions at the session level. We regressed participant sex and environmental concern on the experimental manipulations. The leader charisma and the leader sex effects were not significant in the two models (Table 8). Therefore, the null findings for Hypothesis 1a are unlikely to be driven by effects of the control variables participant sex or concern with the environment.

Table 4
Descriptive Statistics and Correlations Study 1.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Participant sex	0.24	0.43									
2. Age	23.84	5.30	-0.09								
3. Belief	0.99	0.10	0.06	0.02							
4. Concern	4.22	0.75	-0.04	0.18	0.17						
5. English	1.42	0.61	-0.08	-0.02	0.07	-0.34**					
6. Error detection	0.34	0.28	-0.02	0.19	0.12	0.14	-0.09				
7. Memory	0.64	0.09	0.13	0.06	0.18	0.08	-0.06	0.30**			
8. Charisma	0.50	0.50	-0.05	0.01	-0.10	-0.13	0.00	-0.04	-0.20*		
9. Leader sex	0.50	0.50	-0.05	0.09	0.10	0.03	0.07	-0.05	0.03	0.00	
10. Interaction	0.25	0.44	0.00	0.07	0.06	-0.05	0.06	0.07	-0.02	0.58**	0.58**

Note. N = 100; Charisma was coded as 0 = neutral and 1 = charismatic; Leader sex and participant sex were coded as 0 = female and 1 = male; Belief in climate change was coded as 0 = Not believing in climate change and 1 = Believing in climate change; Concern with the environment was measured on a 5-point Likert scale from 1 = *Not at all concerned* to 5 = *Very concerned*; English language proficiency was coded as 1 = Excellent, 2 = Good, 3 = Average, 4 = Poor; Error detection reflects average error detection proportion from 0 = no erroneous information detected to 1 = all erroneous information detected; Memory reflects average memory proportion from 0 = no correct responses to 1 = all statements correctly classified as present/absent. *p < .05. **p < .01.

Table 5
Descriptive Statistics Error Detection and Memory Study 1.

	Error Detection			Memory	
Condition	*n*	*M*	*SD*	*M*	*SD*
Charismatic female	25	0.28	0.27	0.60	0.08
Charismatic male	25	0.37	0.29	0.63	0.08
Neutral female	25	0.42	0.26	0.67	0.09
Neutral male	25	0.27	0.31	0.65	0.11

Table 6
Mixed Effects Model Results of Charisma and Leader Sex on Error Detection Study 1.

Error Detection Variable	Model 1	Model 2	Model 3	Model 4
Fixed effects				
Intercept	−0.68*	−1.85*	−0.37	−1.45
	(0.26)	(0.90)	(0.29)	(0.90)
Leader charisma	−0.10	−0.05	−0.72†	−0.67†
	(0.29)	(0.29)	(0.40)	(0.40)
Leader sex	−0.17	−0.18	−0.79*	−0.80*
	(0.29)	(0.29)	(0.40)	(0.40)
Concern		0.28		0.26
		(0.20)		(0.19)
Participant sex		−0.08		−0.15
		(0.34)		(0.33)
Interaction effect			1.27*	1.26*
			(0.57)	(0.57)
Random effects				
Subject	0.75	0.72	0.68	0.64
	(0.87)	(0.85)	(0.82)	(0.80)
Item	0.03	0.03	0.03	0.03
	(0.18)	(0.18)	(0.19)	(0.19)
R^2	0.195	0.197	0.200	0.200
AIC	509.684	511.628	506.734	508.717
Log likelihood	−249.842	−248.814	−247.367	−246.358

Note. $N = 100$; N items $= 4$. Unstandardized regression coefficients for fixed effects with standard errors in between parentheses and variance for random effects with standard deviations in between parentheses are presented in the table. Charisma was coded as 0 = neutral, 1 = charismatic; Leader and participant sex were coded as 0 = female, 1 = male; Concern with the environment was measured on a 5-point Likert scale from 1 = *Not at all concerned* to 5 = *Very concerned*. †$p < .10$. *$p < .05$.

Table 7
Mixed Effects Model Results of Charisma and Leader Sex on Memory Study 1.

Memory				
Variable	Model 1	Model 2	Model 3	Model 4
Fixed effects				
Intercept	0.81***	0.62†	0.88***	0.70*
	(0.21)	(0.35)	(0.22)	(0.35)
Leader charisma	−0.20*	−0.19*	−0.34*	−0.31*
	(0.10)	(0.10)	(0.13)	(0.13)
Leader sex	0.02	0.03	−0.11	−0.10
	(0.10)	(0.10)	(0.14)	(0.13)
Concern		0.04		0.03
		(0.06)		(0.06)
Participant sex		0.14		0.13
		(0.11)		(0.11)
Interaction effect			0.27	0.25
			(0.19)	(0.19)
Random effects				
Subject	0.05	0.05	0.05	0.05
	(0.23)	(0.22)	(0.22)	(0.22)
Item	1.13	1.13	1.13	1.13
	(1.07)	(1.07)	(1.07)	(1.07)
R^2	0.267	0.267	0.267	0.267
AIC	3470.743	3472.908	3470.697	3473.178
Log likelihood	−1730.372	−1729.454	−1729.349	−1728.589

Note. $N = 100$; N items $= 30$. Unstandardized regression coefficients for fixed effects with standard errors in between parentheses and variance for random effects with standard deviations in between parentheses are presented in the table. Charisma was coded as 0 = neutral, 1 = charismatic; Leader and participant sex were coded as 0 = female, 1 = male; Concern with the environment was measured on a 5-point Likert scale from 1 = *Not at all concerned* to 5 = *Very concerned*. †$p < .10$. *$p < .05$. ***$p < .001$.

Robustness checks

We computed the pre-registered mixed effects models again excluding participants who 1) selected "*Don't know*" on whether they believe in climate change, 2) indicated to be "*Not concerned*" about the environment, 3) failed the attention check, 4) had technical problems throughout the study or 5) failed the sound check. Additionally, we also 6) checked for an interaction effect of leader charisma, leader sex and participant sex. The results of these exploratory robustness analyses largely corroborate with the main pre-registered analyses. There are some minor deviations from the preregistered models. Model 2 for the robustness checks 1–4 on the outcome measure memory showed no significant effect for the charismatic leader condition (1) B = -0.18, p = .064; 2) B = -0.19, p = .063; 3) B = -0.19, p = .074, 4) B = -0.19, p = .055) which may be caused by a smaller sample size for these models due to the exclusion criteria.

Exploratory supplementary analysis of error detection

The error detection outcome measure used in the mixed model analysis is a two-stage composite score of 1) recognizing the statement that was present in the speech and 2) detecting that the information is erroneous. These two outcomes are confounded in the error detection dependent measure of our pre-registered analysis. Therefore, we have added an exploratory analysis in which we estimate the effect of our experimental treatments on the two dependent outcomes (recognizing the presented statement and identifying the information as erroneous) in a set of bivariate models with non-random sample selection. The results of the bivariate models with non-random sample selection are shown in Table 9 with Model 1 reporting the effects of our experimental manipulations, Model 2 reporting the manipulation effects and the covariates environmental concern and participant sex, Model 3 reporting the manipulations and their interaction, and Model 4 reporting all variables and the interaction term for the experimental manipulations for both dependent measures (selection model = recognizing statement; outcome model = identifying statement as erroneous). The charismatic and male leader condition had no significant effect on recognizing the statement that was presented by the leader in Model 1 (charismatic B = -0.06, OR = 0.94, p = .759; male leader B = -0.15, OR = 0.86, p = .475) or Model 2 (charismatic B = -0.03, OR = 0.97, p = .884; male leader B = -0.17, OR = 0.86, p = .425). We did find an interaction effect of the charismatic and male leader condition on recognizing statements in the selection models 3 and 4 (Model 3 B = 1.18, OR = 3.22, p = .005; Model 4 B = 1.17, OR = 3.21, p = .006). On average, participants recognized 32% of the factually incorrect statements in the female and 42% in the male charismatic leader condition, and 47% in the female and 30% in the male neutral leader condition. In these models, the charismatic and male leader condition also had a significant effect (Model 3 charismatic B = -0.64, OR = 0.53, p = .030; male leader B = -0.74, OR = 0.48, p = .013; Model 4 charismatic B = -0.61, OR = 0.55, p = .043; male leader B = -0.75, OR = 0.48, p = .013). In general, the results of the outcome models for error detection with the selected sample showed that the charismatic and male leader condition did not predict the identification of erroneous statements (charismatic: Model 1 B = -0.05, RR = 0.94, p = .735; Model 2 B = -0.06, OR = 0.93, p = .905; Model 3 B = 0.40, OR = 0.98, p = .565; Model 4 B = 0.45, OR = 1.09, p = .561; male leader: Model 1 B = -0.04, RR = 1.07, p = .784; Model 2 B = 0.29, OR = 1.26, p = .562; Model 3 B = 0.71, OR = 1.28, p = .342; Model 4 B = 0.85, OR = 1.50, p = .295). There was no interaction effect of the charismatic and male leader condition on detecting erroneous statements (Model 3 B = -0.93, OR = 0.83, p = .359; Model 4 B = -1.04, OR = 0.73, p = .377). The results of this exploratory analysis are partly in line with the results of the preregistered mixed model analyses. Yet, the results of the bivariate models with non-random sample selection suggest that the effect is only present for the memory component of the error detection task (recognizing that the erroneous statement was presented by the leader). The follow-up pairwise comparisons using a Tukey post-hoc test corrected with Holm's sequential Bonferroni procedure showed no significant contrasts for the memory component.

This exploratory analysis should be interpreted with caution as the selected sample for the error detection outcome models (n = 151) is significantly smaller than the complete sample (N = 400) and is therefore likely to be too small to reliably estimate an interaction effect of leader charisma and male leader sex on identifying information as erroneous.

Table 8
Test of Balance Study 1.

Variable	Model 1 Participant sex	Model 2 Concern
Intercept	−0.94*	4.30***
	(0.39)	(0.13)
Leader charisma	−0.22	−0.20
	(0.47)	(0.15)
Leader sex	−0.22	0.04
	(0.47)	(0.15)
R^2	0.005	−0.001

Note. N = 100. Unstandardized regression coefficients are presented in the table with standard errors in between parentheses. Charisma was coded as 0 = neutral and 1 = charismatic; Leader sex was coded as 0 = female and 1 = male. *p < .05. ***p < .001.

Signal detection analysis

During the memory task, statements were presented one at a time, allowing us to calculate signal detection indices for participants' memory performance. In an exploratory analysis we aimed to further confirm the effect of leader charisma on memory by fitting a linear regression model in which we regressed the sensitivity index D-prime on the charismatic and male leader condition (Table 10). The charismatic condition had a significant effect on D-prime (Model 1 β = -0.40, p = .044, only marginally significant in Model 2 β = -0.38, p = .062, Model 3 β = -0.68, p = .016, Model 4 β = -0.64, p = .026). This exploratory result further supports the hypothesis that participants in the charismatic conditions (D-prime M = 0.20, SD = 0.14) recognized less statements correctly than participants in the neutral leader conditions (M = 0.26, SD = 0.17; supplementary material E).

Method study 2

We used the identical design, participant recruitment strategy, stimuli creation and manipulation check procedures from study 1 to assess (2a) whether participants are persuaded more by factually correct messages, (2b) show more pro-social behavior in the charismatic condition, and to examine the predicted mediation effect of (2c) charisma via the leader's persuasiveness on prosocial behavior.

Materials

Manipulation checks

Pre-test objective manipulation check. The coders agreed on 99% of the 837 coding events for the neutral and 93% of the 873 coding events for the charismatic speech. We only found no or weak interrater reliability for the neutral (κ = -0.01, z = -0.197, p = .844) and charismatic (κ = 0.38, z = 11.1, p < .001) speech. The independent coders reported to initially have had different interpretations of some of the CLTs (e.g., contrasts, sentiments to the collective etc.). Accordingly, when testing for the interrater reliability on the total absence or presence of CLTs per sentence irrespective of the specific tactic used,

Table 9
Results Bivariate Models with Non-Random Sample Selection Study 1.

	Model 1		Model 2		Model 3		Model 4	
Variable	M	E	M	E	M	E	M	E
Intercept	0.08	-0.20	−0.69	0.92	0.37	1.63*	−0.36	0.38
	(0.27)	(0.25)	(0.68)	(1.35)	(0.30)	(0.67)	(0.71)	(2.04)
Leader charisma	−0.06	−0.05	−0.03	−0.06	−0.64*	0.40	−0.61*	0.45
	(0.21)	(0.16)	(0.21)	(0.51)	(0.30)	(0.69)	(0.30)	(0.77)
Leader sex	−0.15	-0.04	−0.17	0.29	−0.74*	0.71	−0.75*	0.85
	(0.21)	(0.16)	(0.21)	(0.50)	(0.30)	(0.75)	(0.30)	(0.81)
Concern			0.18	0.27			0.17	0.33
			(0.14)	(0.29)			(0.15)	(0.41)
Participant sex			0.05	−0.69			−0.01	−0.65
			(0.24)	(0.53)			(0.25)	(0.59)
Interaction					1.18**	−0.93	1.17**	−1.04
					(0.42)	(1.02)	(0.42)	(1.18)
R^2	0.009	0.014	0.008	0.027	0.025	0.011	0.025	0.022
AIC	531.464	109.465	533.930	110.313	525.577	111.208	528.198	112.215
Log likelihood	−261.898	−50.968	−261.130	−49.376	−257.951	−50.814	−257.261	−49.324

Note. $N = 100$; N items = 4; N selected observations for outcome models $n = 151$. Unstandardized regression coefficients are presented in the table with standard errors in between parentheses. M = Memory selection model; E = Error detection outcome model; Test of independence between two categorical outcomes memory and error detection: $\chi^2(1) = 296.58$, $p < .001$. Charisma was coded as 0 = neutral, 1 = charismatic; Leader and participant sex were coded as 0 = female, 1 = male; Concern with the environment was measured on a 5-point Likert scale from 1 = *Not at all concerned* to 5 = *Very concerned*. *$p < .05$. **$p < .01$.

Table 10
Regression Results for d-prime for Memory Task Study 1.

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	0.26***	0.20*	0.28***	0.22*
	(0.03)	(0.10)	(0.03)	(0.10)
Leader charisma	−0.06*	−0.06†	−0.11*	−0.10*
	(0.03)	(0.03)	(0.04)	(0.04)
Leader Sex	0.01	0.01	−0.04	−0.03
	(0.03)	(0.03)	(0.04)	(0.04)
Concern		0.01		0.01
		(0.02)		(0.02)
Participant sex		0.05		0.04
		(0.04)		(0.04)
Interaction			0.09	0.08
			(0.06)	(0.06)
F statistic	2.121	1.499	2.108	1.545
R^2	0.022	0.020	0.032	0.027

Note. $N = 100$. Unstandardized regression coefficients are presented in the table with standard errors in between parentheses. Charisma was coded as 0 = neutral and 1 = charismatic; Leader sex was coded as 0 = female and 1 = male. †$p < .10$. *$p < .05$. ***$p < .001$.

the reliability increased (neutral speech: $\kappa = 0.19$, $z = 1.93$, $p = .054$; charismatic speech: $\kappa = 0.45$, $z = 4.32$, $p < .001$). The coders reconciled the differences until they reached agreement (supplementary material C). The number of CLTs used in the neutral speech as proportion of total sentences was 7.53% (7 CLTs over 93 sentences) as opposed to a proportion of 60.82% (59 CLTS over 97 sentences) in the charismatic speech. The proportions of CLTs used in the neutral (7 / 93) and charismatic speech (59 / 97) were significantly different, χ^2 (1) = 57.17, $p < .001$. The number of gestures and facial expressions (charismatic female: 205; charismatic male: 153; neutral female: 21; neutral male: 22) was statistically significantly associated with the condition of the speech (χ^2 (3) = 52.58, $p < .001$).

Pre-test subjective manipulation check. Fifty-four participants (female = 42; $M_{age} = 20.30$; $SD = 2.63$) rated one of the four videos for study 2 on the five charisma items (Grabo & van Vugt, 2016; "*charismatic*", "*likable*", "*enthusiastic*", "*inspiring*", "*warm*"; Cronbach's $\alpha = 0.79$). We calculated a composite score for charisma per participant (Table 11) and fitted a multiple regression model with the interaction term and main effects for leader charisma and leader sex. The overall regression was statistically significant (adjusted $R^2 = 0.17$, F (3, 50) = 4.66, $p = .006$). The leader charisma coefficient significantly predicted charismatic ratings ($B = 0.55$, $se = 0.25$, $p = .031$, partial $\eta^2 = 0.21$). There was no significant main effect of leader sex (B = -0.15, $se = 0.25$, $p = .565$) or interaction effect of leader charisma and leader sex on charisma ratings ($B = 0.16$, $se = 0.35$, $p = .648$). We dropped the interaction effect and fitted an additional model with the main effects for leader charisma and leader sex. The overall regression was statistically significant (adjusted $R^2 = 0.18$, F (2, 51) = 6.99, $p = .002$). The leader charisma coefficient significantly predicted charismatic ratings ($B = 0.64$, $se = 0.17$, $p < .001$, partial $\eta^2 = 0.21$). There was no significant main effect of leader sex (B = -0.06, $se = 0.17$, $p = .719$). The leaders in the charismatic conditions ($M = 4.18$, $SD = 0.52$) were rated significantly more

Table 11
Means and Standard Deviations Charisma Ratings Pre-Test Study 2.

Condition	*n*	*M*	*SD*
Charismatic female	14	4.17	0.56
Charismatic male	14	4.19	0.49
Neutral female	12	3.62	0.75
Neutral male	14	3.47	0.73

Note. Charisma ratings for each video were obtained in a separate pilot study, independent of the experimental study.

charismatic than the leaders in the neutral conditions (M = 3.54, SD = 0.73). The results of our subjective manipulation checks are comparable to results from earlier studies using CLTs to manipulate charisma (η^2 = 0.28; Grabo & van Vugt, 2016). Additionally, extracts of the same videos were used in other experimental studies and tested accordingly in separate validation studies, supporting the difference in perceived charisma between the charismatic and neutral condition (supplementary material F).

Dependent measures

Persuasion task

Pre-test statement selection. To assess whether participants are persuaded by factually correct information, we selected 20 statements conveying information about climate change and sustainability from the pilot set of emotionally neutrally rated statements ($M_{Valence}$ = 3.88, SD = 1.07, $M_{Arousal}$ = 4.06, SD = 0.94). For example, "*Global warming defines a long-term rise in the earth's temperature.*".

Task. Participants read the 20 emotionally neutral statements that were presented during the speech. Statements were presented in a randomized order, one statement at a time. Participants were informed that all statement were taken from the speech. After each statement, participants were asked: "*Does this statement persuade you?*". Participants responded by selecting either "*Yes*" or "*No*". Per statement, the dependent variable persuasion was coded as 0 (= *Not persuaded*) or 1 (= *Persuaded*).

Donation task

At the end of the speech, the leader asked the participants to donate some of their experimental earnings to a local environmental organization at their university. Participants could indicate this by selecting any whole number on a scale from EUR 0 to 8, immediately after they viewed the speech. The amount that the participants donated was deducted from their payment and donated to the environmental organization at their university.

Procedure

The main experimental procedure was identical to study 1. Participants completed the study online, while attending a video call with the experimenter. After giving informed consent, participants were randomly assigned to one of the four conditions and watched the respective speech. At the end of the speech, the leader invited the participants to donate a share of their experimental earnings to a local environmental institution located at the participants' university. Immediately after listening to the speech, participants indicated the amount of money they wanted to donate to the environmental organization. Next, participants completed the cognitive persuasion task and answered the attention check question. The debriefing procedure was identical to study 1.

Results study 2

We performed all statistical analyses in R (R Core Team, 2022). The data was collected between April and September 2021. Means, standard deviations and correlations of all variables are shown in Table 12.

Sample

We recruited 140 participants for study 2 (female = 95, M_{age} = 23.09, SD = 3.53). Participants received up to EUR 8 for their participation, depending on how much of their experimental earnings they donated at the end of the study. Ninety-nine percent of the participants indicated to believe in climate change, two participants selected "*Rather not say*". Sixty-nine percent of the participants indicated excellent, 26% good, 5% average, and one participant poor English language proficiency. Forty-six percent of the participants indicated to be very concerned with the environment (5-point Likert scale from (1) *Not at all* to (5) *Very concerned*; 41% = 4; 12% = 3; one participant = 2). Because the leader asked participants to donate to an environmental organization active at the two local universities at the end of the speech, we only recruited students from these universities. Therefore, we asked participants whether they are students or not, and at which institution they were enrolled. One-hundred thirty participants reported to be students, seven participants had been students at one of the universities and three participants were no students.

Persuasion

The results of the mixed models analyses are shown in Table 14 with Model 1 reporting the main effects of the experimental manipulations, Model 2 reporting the main effects while controlling for environmental concern and participant sex, Model 3 including the main effects and their interaction term and Model 4 reporting the main effects, their interaction term and the control variables. Participants were persuaded by 54% of the statements in the female and 58% in the male charismatic leader condition, and 58% in the female and 63% in the male neutral leader condition (Table 13). There was no statistically significant effect of leader charisma on persuasion (Model 1 B = -0.29, OR = 0.75, p = .326; Model 2 B = -0.25, OR = 0.78, p = .393; Model 3 B = -0.22, OR = 0.80, p = .588; Model 4 B = -0.17, OR = 0.84, p = .680). Therefore, Hypothesis 2a, that participants in the charismatic condition are more persuaded by factually correct and emotionally neutral messages than participants in the neutral condition, was not supported. There was no significant interaction effect of the charismatic and male leader condition on persuasion (Model 3 B = -0.13, OR = 0.88, p = .821; Model 4 B = -0.16, OR = 0.85, p = .780). The male leader condition also had no significant influence on persuasion (Model 1 B = 0.24, OR = 1.27, p = .415; Model 2 B = 0.24, OR = 1.27, p = .404; Model 3 B = 0.30, OR = 1.35, p = .458; Model 4 B = 0.32, OR = 1.38, p = .427).

Bayes factor

To quantify the evidence for the null hypothesis that there is no main effect of leader charisma on persuasion, we fitted the data to Bayesian models using the 'brms' package. We regressed participants' persuasion of information per statement (0 = *Not persuaded*, 1 = *Persuaded*) on the sex of the leader and the covariates environmental concern and participant sex, and the random intercepts per participant and item. We compared this model to the full model which includes the main effect of charisma. The Bayesian analysis indicated weak anecdotal evidence for the alternative hypothesis (BF_{01} = 0.93), that leader charisma has an effect on persuasiveness of factual information. Therefore, the null and alternative model are almost equally likely, and the data does not provide decisive evidence for either an absence or presence of an effect of charisma on leader persuasiveness.

Donations

The results of the multiple regression analyses are shown in Table 15 with Model 1 reporting the main effects of the experimental manipulations, Model 2 reporting the main effects while controlling for environmental concern and participant sex, Model 3 including the main effects and their interaction term and Model 4 reporting the main effects, their interaction term and the control variables. We excluded two participants from the analysis of the dependent measure donation because of invalid or missing values for the donation task caused by technical problems. Participants donated on average EUR 2.34 in the female and EUR 2.47 in the male charismatic leader condition, and EUR 2.47 in the female and EUR 3.11 in the male neutral leader condition (Table 13). The charismatic leader condition had no

Table 12
Means, Standard Deviations and Correlations Study 2.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Participant sex	0.33	0.47									
2. Age	23.11	3.52	0.23**								
3. Belief	0.99	0.12	-0.04	-0.12							
4. Concern	4.31	0.71	-0.15	0.04	0.22**						
5. English	1.38	0.62	-0.07	-0.12	-0.02	-0.17*					
6. Donation	2.60	2.95	-0.01	0.16	0.07	0.26**	-0.14				
7. Persuasion	0.58	0.29	-0.03	0.10	-0.11	0.14	0.08	0.12			
8. Charisma	0.49	0.50	0.07	-0.01	-0.00	-0.10	-0.10	-0.07	-0.08		
9. Leader sex	0.49	0.50	-0.03	0.11	-0.00	-0.02	-0.08	0.07	0.08	-0.02	
10. Interaction	0.23	0.42	-0.02	0.05	0.07	-0.05	-0.11	-0.02	0.00	0.57**	0.57**

Note. $N = 138$; Two participants were excluded because of invalid entries for the donation task. Charisma was coded as 0 = neutral and 1 = charismatic; Leader sex and participant sex were coded as 0 = female and 1 = male; Belief in climate change was coded as 0 = Not believing in climate change and 1 = Believing in climate change; Concern with the environment was measured on a 5-point Likert scale from 1 = *Not at all concerned* to 5 = *Very concerned*; English language proficiency was coded as 1 = Excellent, 2 = Good, 3 = Average, 4 = Poor; Donations ranged from EUR 0 to 8; Persuasion proportion ranged from 0 = not persuaded by any statement to 1 = persuaded by all statements. *$p < .05$. **$p < .01$.

Table 13
Descriptive Statistics Persuasion and Donations Study 2.

	Persuasion			Donations		
Condition	*n*	*M*	*SD*	*n*	*M*	*SD*
Charismatic female	35	0.54	0.30	35	2.34	2.95
Charismatic male	33	0.58	0.30	32	2.47	2.74
Neutral female	36	0.58	0.30	36	2.47	2.81
Neutral male	36	0.63	0.27	35	3.11	3.33

Note. Two participants were excluded from for the donation task because of invalid data entries.

Table 14
Mixed Effects Model Results of Charisma and Leader Sex on Persuasion Study 2.

Persuasion				
Variable	Model 1	Model 2	Model 3	Model 4
Fixed effects				
Intercept	0.43	−0.78	0.39	−0.83
	(0.28)	(0.97)	(0.31)	(0.99)
Leader charisma	−0.29	−0.25	−0.22	−0.17
	(0.29)	(0.29)	(0.41)	(0.41)
Leader sex	0.24	0.24	0.30	0.32
	(0.29)	(0.29)	(0.41)	(0.40)
Concern		0.27		0.28
		(0.21)		(0.21)
Participant sex		0.01		0.00
		(0.32)		(0.32)
Interaction effect			−0.13	−0.16
Random effects			(0.59)	(0.58)
Participant	2.64	2.59	2.64	2.59
	(1.62)	(1.61)	(1.62)	(1.61)
Item	0.30	0.30	0.30	0.30
	(0.55)	(0.55)	(0.55)	(0.55)
R^2	0.475	0.474	0.475	0.474
AIC	3069.956	3072.209	3071.905	3074.132
Log likelihood	−1529.978	−1529.105	−1529.952	−1529.066

Note. $N = 140$; N items = 20. Unstandardized regression coefficients for fixed effects with standard errors in between parentheses and variance for random effects with standard deviations in between parentheses are presented in the table. Charisma was coded as 0 = neutral, 1 = charismatic; Leader and participant sex were coded as 0 = female, 1 = male; Concern with the environment was measured on a 5-point Likert scale from 1 = *Not at all concerned* to 5 = *Very concerned*.

significant effect on making donations (Model 1 β = -0.13, $p = .453$; Model 2 β = -0.08, $p = .628$; Model 3 β = -0.04, $p = .855$; Model 4 β = 0.02, $p = .943$). Hypothesis 2b was not supported. There was no significant interaction effect of the charismatic and male leader condition (Model 3 β = -0.17, $p = .611$; Model 4 β = -0.20, $p = .549$). The male leader condition also had no significant effect on making donations (Model 1 β = 0.13, $p = .439$; Model 2 β = 0.14, $p = .385$; Model 3 β = 0.22, $p = .364$; Model 4 β = 0.24, $p = .300$). There was a significant effect of the control variable concern with the environment on making donations (Model 2 β = 0.26, $p = .002$, partial $\eta^2 = 0.07$; Model 4 β = 0.27, $p = .002$, partial $\eta^2 = 0.07$).

Bayes factor

To quantify the evidence for the null hypothesis that there is no main effect of leader charisma on donations made, we fitted the data to Bayesian models using the 'brms' package. We regressed participants' donations (EUR 0–8) on the sex of the leader and the covariates

Table 15
Multiple Regression Results of Charisma and Leader Sex on Making Donations Study 2.

Donations				
Variable	Model 1	Model 2	Model 3	Model 4
Intercept	2.60***	−2.28	2.47***	−2.44
	(0.43)	(1.63)	(0.50)	(1.65)
Leader charisma	−0.38	−0.24	−0.13	0.05
	(0.50)	(0.49)	(0.71)	(0.69)
Leader sex	0.39	0.43	0.64	0.71
	(0.50)	(0.49)	(0.71)	(0.69)
Concern		1.09**		1.10**
		(0.35)		(0.35)
Participant sex		0.25		0.23
		(0.53)		(0.53)
Interaction effect			−0.52	−0.59
			(1.01)	(0.99)
F statistic	0 .594	2.738	0.480	2.252
R^2	−0.006	0.048	−0.012	0.044
AIC	696.322	690.610	698.054	692.234
Log likelihood	−344.161	−339.305	−344.027	−339.117

Note. $N = 138$. Unstandardized regression coefficients are presented in the table with standard errors in between parentheses. Charisma was coded as 0 = neutral, 1 = charismatic; Leader and participant sex was coded as 0 = female, 1 = male; Concern with the environment was measured on a 5-point Likert scale from 1 = *Not at all concerned* to 5 = *Very concerned*. Donations ranged from EUR 0 to 8. $^{**}p < .01$. $^{***}p < .001$.

environmental concern and participant sex. We compared this model to the full model which includes the main effect of charisma. The model comparison indicated weak anecdotal evidence for the alternative hypothesis ($BF_{01} = 0.72$). Thus, under the observed data, there is no strong indication that the evidence is more in favor of the null or the alternative model.

Mediation analysis

The mediation analysis was not estimated as planned because there was no significant effect of leader charisma on being persuaded by the statements or on making donations.

Exploratory analyses

Test of balance

Participants were randomly assigned to conditions at the session level. We regressed participant sex and environmental concern on the experimental manipulations. The leader charisma and leader sex effect were not significant in the two models (Table 16). Therefore, the null findings for Hypothesis 2a and 2b are unlikely to be driven by effects of the control variables participant sex or concern with the environment.

Table 16
Test of Balance Study 2.

Variable	Model 1 Participant Sex	Model 2 Concern
Intercept	−0.81**	4.39***
	(0.31)	(0.10)
Leader charisma	0.28	−0.14
	(0.36)	(0.12)
Leader sex	−0.15	−0.01
	(0.36)	(0.12)
R^2	0.006	−0.005

Note. $N = 140$. Unstandardized regression coefficients are presented in the table with standard errors in between parentheses. Charisma was coded as 0 = neutral and 1 = charismatic; Leader sex was coded as 0 = female and 1 = male. $^{**}p < .01$. $^{***}p < .001$.

Robustness checks

We computed the pre-registered mixed effects and multiple regression models again excluding participants who 1) indicated poor English language proficiency, 2) responded "*Rather not say*" on whether they believe in climate change, 3) indicated to be "*Not concerned*" about the environment, 3) were no students, 4) failed the attention check, 5) had technical problems throughout the study, or 6) failed the sound check. In addition, we computed the models 7) with an additional covariate controlling for which of the two universities the participants were recruited from. The results of these robustness analyses corroborate the main analyses. There were no main effects of leader charisma on being persuaded by factual information or donations made. When 8) controlling for a three-way interaction effect of leader charisma, leader sex and participant sex (model statistics adjusted $R^2 = 0.05$, F (8, 129) = 1.903, $p = .065$), there was a non-significant interaction effect of the charismatic leader condition and male participant on donations made (B = -2.69, p = .068).

Recognizing leader's name

The leader's name was shown in an animation at the beginning and end of each video. In addition, the leaders introduced themselves in the first sentence of the speech by giving their name. In study 2, the attention check question was asked at the end the study. In contrast, in study 1, we asked the question immediately after participants viewed the video. In both studies, we asked participants to select the leader name from two options (male leader: Steve or Simon; female leader: Mary or Maya). This attention item maps onto the memory and error detection task from study 1 (i.e., recognizing information that was presented during the speech and distinguishing it from a distractor). We conducted an exploratory analysis on the effect of leader charisma on correctly identifying the name of the leader in the attention check question at the end of study 2. We fitted a generalized linear model in which we regressed participants' selection of the leader name (0 = *Incorrect*, 1 = *Correct*) on the charismatic and male leader condition, including the interaction term of the charismatic and male leader condition, and the covariates environmental concern and participant sex. The results of the model which includes the main effects for the charismatic and male leader condition, their interaction effect (Model 1) and the model that additionally included the control variables participant sex and environmental concern (Model 2) showed a significant interaction effect of leader charisma and the male leader on correctly

selecting the leader name (Model 1 B = 3.96, se = 1.37, OR = 52.38, p = .004; Model 2 B = 3.94, se = 1.37, OR = 51.53, p = .004). There was a significant main effect of leader charisma (Model 1 B = -2.64, se = 1.08, OR = 0.07, p = .015; Model 2 B = -2.59, se = 1.09, OR = 0.07, p = .017) but the male leader condition had no significant effect (Model 1 B = -2.13, se = 1.10, OR = 0.12, p = .052; Model 2 B = -2.12, se = 1.10, OR = 0.12, p = .054). Post-hoc Tukey tests corrected with Holm's sequential Bonferroni procedure showed a (marginally) significant difference between the charismatic and neutral female condition (Model 1 B = -2.64, se = 1.08, z = -2.44, p = .044; Model 2 B = -2.59, se = 1.09, z = -2.39, p = .051). Participants in the female charismatic condition identified the correct name less often (M = 0.71, SD = 0.46) than participants in the neutral female condition (M = 0.97, SD = 0.17). There were no significant effects of leader charisma or any other predictors on selecting the correct name of the leader in study 1.

Discussion

In this paper, we set out to examine whether followers minimize the cognitive effort invested – resulting in the superficial cognitive processing of information – when listening to and viewing a particularly charismatic leader. In two studies, we examined cognitive information processing outcomes after exposure to a charismatic or neutral leader. In study 1, we tested participants' ability to detect factually false information and identify emotionally neutral statements that were presented by a charismatic or neutral leader. In study 2, we assessed the persuasiveness of emotionally neutral messages and followers' subsequent willingness to act pro-socially by donating some of their experimental earnings to a local environmental organization. We hypothesized that participants would detect less incorrect information and remember fewer statements from a charismatic compared to a neutral leader, but would be more persuaded by information and donate more after listening to the charismatic leader, regardless of the leader's sex. We further hypothesized a mediating effect of charismatic leaders' persuasiveness on participants' behavior.

Study 1

In study 1, we did not find a main effect of leader charisma on detecting factually incorrect statements presented by a charismatic leader. Thus, we did not find evidence for Hypothesis 1a, and Bayesian analyses provided inconclusive evidence for the null hypothesis indicating that more data would be necessary to decide between both hypotheses. Participants in the charismatic leader condition did not detect fewer erroneous statements than participants in the neutral condition. On average, participants identified approximately-one-third of the factually false statements (i.e., as being incorrect and presented by the leader). Thus, there was no ceiling effect of spotting erroneous information, but the task seemed to be rather difficult to complete for participants across all conditions. The error detection task took place after participants listened to and viewed the leader's speech. Therefore, we could not assess online recognition and processing of erroneous information, which might differ from identifying incorrect statements after listening to the leader, i.e., examining the cognitive outcomes of the information processes rather than the real-time processing mechanisms.

We did, however, find support for our hypothesized main effect of leader charisma on memory for information presented by the leader. Hypothesis 1b is supported by the data. Participants in the charismatic leader condition correctly identified factual information that was or was not presented by the leader less often than participants in the neutral leader condition. Our results suggest an effect of leader charisma on participants' ability to recognize statements presented by a charismatic leader. This finding supports our argument that followers of charismatic leaders reduce their cognitive effort when processing factually neutral information provided by the leader. Accordingly, participants might have processed the information in the charismatic leader condition superficially. In line with the *minimal cognitive effort* hypothesis, we propose that this prevented participants from in-depth cognitive processing of the factual and emotionally neutral statements presented by the charismatic leaders and increased the difficulty of identifying whether the information was or was not part of the speech during the task.

Exploratory findings

We found an unpredicted interaction effect of leader charisma and leader sex on error detection. Participants in the charismatic female condition tended to identify fewer factually incorrect statements compared to the neutral female condition. But participants in the charismatic male condition detected more factually incorrect statements than in the neutral male condition. However, when correcting for multiple comparisons in our post-hoc analyses, none of the pairwise comparisons remained statistically significant. In an additional exploratory analysis, using bivariate models with non-random sample selection, the outcome of the error detection task was split into results for the memory component (1) identifying which statement was present in the speech) and the error detection component (2) identifying the statement as erroneous). Results did not show an interaction effect for the charismatic and male leader condition on identifying erroneous statements. Instead, the bivariate analyses showed an interaction effect of leader charisma and the male leader condition on recognizing the erroneous statements only (memory component of the task).

The processes involved in memorizing erroneous information provided by the leader are likely to be different from recognizing factually correct and emotionally neutral information as tested in the memory task in study 1. The former is likely to draw attention to the information while listening to the leader due to the attention-grabbing character of the information (i.e., erroneous information is likely more salient), making the information more memorable. Our data also implies that the direction of this effect might be dependent on the leader's sex. The memory processes in the second task of study 1 (memory task for emotionally neutrally rated statements) are not influenced by such stimuli inherent factors as we only tested emotionally neutral and factual statements (i.e., there was no violation of expectation due to the false information contained in the statement when processing it). Therefore, memorizing and identifying the statements as erroneous in the error detection task are two intertwined online-cognitive processes. This potentially caused a ceiling effect of correctly identifying the information as false in the second part of the error detection task (after recognizing the statement from the speech), and may explain the absence of a significant effect in the outcome models of the bivariate model analyses. In particular, in the case that participants correctly remembered an erroneous statement from the speech (n = 151), they also identified in a majority of the cases (n = 134) that the statement was erroneous. We suggest that the statements that were remembered by participants were likely to be remembered because participants identified them as false while listening to the statement during the speech (online processing). For example, negative stimuli capture attention more than neutral information (Ohman et al., 2001). Therefore, when the follower notices that the leader presents erroneous information, this is likely to trigger affective and cognitive processes in the follower similar to a cheater detection mechanism (Cosmides, 1989). Second, in many cases participants did not recognize the erroneous statements as being part of the speech (n = 249). This may be indicative of high task difficulty or a general effect of leadership on less attention being directed towards erroneous information. Further research on this topic in the context of information processes and the leader–follower dyad is needed.

Given this theoretical framework, the mixed results for the error detection task from the linear mixed effects and the bivariate models should be interpreted with caution given that the sample size to reliably detect an interaction effect is likely to be too small, especially concerning the significantly smaller number of observations ($n = 151$ compared to $N = 400$ items in total) in the outcome models of the bivariate analyses.

An exploratory analysis for the memory task further confirmed the results for the preregistered memory task analysis by examining the signal detection sensitivity index d-prime (supplementary material E). The results matched the mixed model analysis and further support Hypothesis 1b that participants recognized information less often when presented by a charismatic compared to a neutral leader.

The exploratory findings for the error detection task provide an indication that the same leadership style may have different cognitive outcomes depending on the leader's sex (Schlamp et al., 2019; Wolfram & Gratton, 2014). The results point towards the importance of investigating the influence of the leader's sex on the cognitive outcomes of the charismatic signaling process. We suggest that CLTs used by a female leader potentially lead to different cognitive processing strategies in followers, causing them to pay less attention towards erroneous information provided by the female leader, as compared to a male leader who uses similar CLTs. Accordingly, several authors have suggested that female leaders are placed within a double bind in which maintaining their gender role results in failing to meet leadership expectations (Costa, 2021; Kubu, 2018). Similarly, other researchers have stated that women are not different in their leadership qualities but receive different reactions for their leadership behavior compared to men (Schlamp et al., 2019). However, some researchers suggested that charismatic leadership seems to be a special case in which women need to invest more to be attributed as much charisma as men, reflected in different reactions of the audience (Novák-Tót et al., 2017). Yet, in our subjective manipulation checks we did not find a difference on charismatic perceptions between the female and male actor. This could be related to self-reported charisma perceptions potentially being different from the cognitive mechanisms involved in processing information from a female or male leader (implicit *versus* explicit measures). Followers might only show *minimal cognitive effort* when being exposed to a charismatic female leader, and not when listening and viewing a charismatic male leader, and the presentation of erroneous information might present a special context for the effect to occur. Additionally, many studies that examined the influence of CLTs on true follower behavioral outcomes used male leaders only or neutral sex stimuli (Antonakis et al., 2011; Fest et al., 2021; Meslec et al., 2020). Our unpredicted and inconclusive results for the error detection task do not allow us to draw reliable conclusions on whether the cognitive outcomes differ depending on the leader's sex. Follow-up studies should investigate sex differences for the charismatic effect by using multiple female and male leaders to control for confounding effects of a particular person. Thus, further research is needed to resolve this mixed evidence with regard to both the cognitive and behavioral outcomes of the charismatic signaling process.

Study 2

In study 2, we did not find support for an effect of leader charisma on the persuasiveness of statements (Hypothesis 2a) and donations made to an environmental organization (Hypothesis 2b). Accordingly, we rejected a mediating effect of leader charisma via the leader's persuasiveness on donations made (Hypothesis 2c). Bayesian models for Hypotheses 2a and 2b provide inconclusive evidence for the null or the alternative hypothesis. Therefore, we obtained indecisive results for the absence or presence of an effect of leader charisma on the persuasiveness of factually correct and emotionally neutral information, and pro-social actions in the form of donations made to an environmental organization.

We suggest several reasons for these unexpected null findings. First, the amount of emotionally neutral and fact-based information in the speeches might have negatively impacted the charismatic perception of the leaders, undermining the effect of the verbal CLTs implemented in the leader's messages. Especially, charismatic leadership unfolds through signaling emotions, identities, and values (Antonakis et al., 2016). The speech, however, contained 20 emotionally neutrally rated, factually correct statements which do not include any tactic and, therefore, are in salient contrast to the verbal CLTs. This potentially undermined the effect of the charismatic signaling process.

Second, the majority of the participants were concerned with the environment and believed in climate change. Therefore, they did not need to be persuaded by the factual information on climate change and sustainability because the vast majority of participants believed in climate change and were concerned with the environment already. For example, participants across all conditions were persuaded by more than half of the statements. Additionally, environmental concern was related to donating for an environmental organization, providing a proof-of-concept of the validity of our measures and pointing to the relevance of the studies' context to the participant pool.

Third, we did not ask participants whether they were persuaded about taking a specific action against climate change. The charismatic signaling process might have a different effect on statements that call for specific actions – for example, joining an environmental activist group, or working as a volunteer. Although we did not find an effect of leader charisma on donating to an environmental organization, our data does not allow us to investigate the effect of leader charisma on other individual or collective actions such as behavioral changes to support the sustainability movement (e.g., using public transport or joining a demonstration). Thus, the implementation of the persuasion task does not align with the whole spectrum of the leader's persuasiveness aimed at convincing followers to take collective actions and mobilize their forces in a coordinated group action (Antonakis et al., 2016).

Exploratory findings

In an additional exploratory analysis, we found evidence that participants identified the leader's name correctly less often in the charismatic than in the neutral female leader condition. This result further provides insight into potential cognitive information processing differences and outcomes for followers of charismatic female compared to male leaders. In sum, our exploratory analyses from both studies point towards the importance of investigating charismatic leadership effects on followers' cognition in the light of the leader's sex.

Strengths of research

To our knowledge, these are the first studies that have investigated the effect of leader charisma on cognitive outcomes in followers. Our manipulation of charismatic leadership aligns with the most recent and widely accepted definition of charisma as a signal, quantified by a specific set of nine verbal and three non-verbal tactics (Antonakis et al., 2011, 2016). We chose the context of sustainability and climate change and correspondingly created relevant stimuli to increase the credibility of the leader–follower setting for the participant population. By rigorously testing the statements for the cognitive tasks, the speeches and videos, we could separate the effect of the charismatic signaling further from potential confounds, such as the emotional valence of the tested statements themselves on cognitive outcomes. Initially, we aimed at improving the generalizability of our findings by examining these effects for both a female and male leader. While our design does not allow us to draw specific theoretical conclusions due to only manipulating the leader sex with one female and male

actor, we gained first insights into the potential and unpredicted role of leader sex on the cognitive outcomes of the charismatic signaling process. Specifically, the memory component of processing erroneous information is an interesting case to investigate further in light of potential leader sex differences and our study hopefully encourages further research into this domain.

Limitations and future research

We tested the influence of leader charisma only on the processing outcomes for emotionally neutral and factually correct or incorrect information. We wanted to prevent confounding effects of emotionally loaded information in the testing statements and aimed at separating the charismatic signaling that builds on emotions, identities, and values from the stimuli used in the cognitive tasks. However, these precautions to isolate the charismatic effect might have weakened the influence of the verbal CLTs used in the speeches because the factual statements were in sharp contrast to the emotionally loaded tactics. The neutral information could have obscured the verbal CLTs, which otherwise invoke strong charismatic effects (Antonakis et al., 2016). Therefore, the emotionally neutral statements potentially outbalanced the verbal CLTs. Future research needs to explore how charismatic signaling affects the processing of other information, beyond factual sentences. Testing and implementing information that is more in line with the verbal CLTs will enable a more natural and consistent speech pattern for the charismatic leader.

Future studies should consider other processing areas that are potentially subject to the charismatic signaling process, such as emotional and contextual interpretation of leaders' messages. We only assessed cognitive outcomes and did not include other forms of processing outcomes (e.g., emotional, figurative). For example, how followers exactly process figurative language or other rhetorical tactics used by charismatic leaders on a cognitive or affective level remains unclear. Figurative language processing (e.g., interpreting the meaning of a metaphor) moves beyond the literal meaning of the words and therefore, could have different processing outcomes than the emotionally neutral information assessed in our studies. The absence or presence of charismatic signaling tactics might also affect the actual perception of the emotional valence of information. For example, factually incorrect statements could cause a negative emotional effect if the follower notices that the leader is not telling the truth (cf. cheater detection mechanisms; Bøggild, 2020).

Follow-up research should not only focus on different forms of information or processing styles, but also investigate the exact attention mechanisms to factual or other information presented by charismatic leaders in real-time (for example, using neurophysiological measures or eye-tracking) and its outcomes (i.e., recognition of messages) to further explore the *minimal cognitive effort* hypothesis. Other cognitive outcome variables have the potential to further explain the mechanisms of the charismatic signaling process. For example, cognitive speed might decrease with the charisma of the leader because of less invested cognitive effort, i.e., followers process information faster.

The role of potential contextual covariates needs to be explored further. In our study, environmental concerns were related to the donations made by participants. However, the majority of the participants indicated to be concerned or very concerned with the environment. The low variation on this measure across participants does not allow us to scrutinize this effect in detail, by for example, assessing how it affects the outcome of the charismatic signaling process. Drawing from a broader population of participants who vary more in their concerns for the environment would allow such an assessment. In addition, the majority of the participants were interested in sustainability and climate change, and therefore, did not need to be convinced by factual information about these topics. Due to their affinity with the environmental and climate change movement, participants might have been familiar with many of the facts presented to them. Thus, the persuasive powers of the leader were not necessary since the followers believed in the shared cause already – they did not need to be convinced. Future research should explore the effects of leader charisma on followers' processing outcomes of previously unfamiliar information, and the role of contextual factors in this relationship (e.g., pro or contra environmentalism or political orientation).

Importantly, in our studies, we only had one female and one male actor to manipulate the sex of the leader. The actors were selected to be comparable along several dimensions, such as speaking with British accent, hair color, and a comparable height. Yet, there are other person specific characteristics that may have affected the outcome measures. To reliably disentangle a possible effect of leader sex and person specific effects on the cognitive outcomes of the charismatic signaling process, future studies should manipulate the sex of the leader by using multiple female and male actors.

We only found weak interrater reliability for our objective manipulation checks. After coding the experimental speeches, the raters indicated that they initially have had different interpretations of some of the CLTs (e.g., contrasts and sentiments to the collective). This was further implied by increased reliability scores for sentence coding events irrespective of the specific CLT. However, we would like to note that extracts of the videos have been used in other experiments. The use of CLTs in these video extracts was validated in other, separate online studies, demonstrating the significant difference in subjective perceived charisma ratings between the neutral and charismatic speeches (supplementary material F), thereby further substantiating our claim that our charisma manipulation was effective.

Due to COVID-19 our studies were moved from a lab to an online environment, posing additional limitations on the study designs. To minimize the influence of an online test environment on our measurements, participants were present in a video call while completing the study. Although participants and the experimenter switched off their camera and microphone while participants completed the tasks, the presence in the video call ensured that participants completed the study in one session. We further implemented a sound and video check to verify that participants could watch the leader's speech without encountering technical problems. Moving lab studies to an online setting is commonly applied in cognitive psychological studies (Sauter et al., 2020). Researchers have also successfully replicated cognitive and behavioral lab designs in online studies (Nussenbaum et al., 2020; Yang and Krajbich, 2020).

Our data indicate that the sample size might be too small to draw reliable conclusions. The ex-ante power analyses were calculated under the assumption of a larger effect of leader charisma on the cognitive outcomes, and without simulating an interaction effect of leader charisma and leader sex. Therefore, to reliably estimate the unpredicted interaction of charisma and leader sex or the main effect of leader charisma on the cognitive outcomes, the sample size is likely too small. This is further implied by the large confidence intervals of the mixed model fits and the small odds ratios for the effect of leader charisma on detecting erroneous information and recognizing information from the speech. Furthermore, Bayesian analyses showed Bayes factor values smaller than 10, which only provide inconclusive evidence for our findings. Under our observed data, the null or the alternative models are almost equally likely (Jarosz & Wiley, 2014), suggesting that indeed more participants would be needed to detect an effect.

Conclusion

In our studies, we investigated the *minimal cognitive effort* hypothesis according to which followers are more likely to superficially process information from particularly charismatic leaders. We did not find support for the effect of charisma on detecting factually false information, but our data shows that participants recognized less of the information presented by a charismatic leader. We did not find evi-

dence that exposure to charismatic leaders increases the persuasiveness of factual messages or pro-sociality in followers (unlike previous studies; Grabo & van Vugt, 2016). Our studies provide first insights into the presence or absence of cognitive effects that charismatic leaders have on their followers. Future research that utilizes different types of information and explores other forms of cognitive processing and outcomes is needed to further investigate the effects of the charismatic signaling process.

Supplementary materials

Online repository for data, materials, analyses scripts: https://osf.io/h32b4/?view_only=6edc1a8378b24cac9ff2042af81b36da

Author Note

We wish to thank the editor of this registered report, as well as the three anonymous reviewers for their feedback and suggestions which were invaluable in improving this manuscript. We also like to thank Reinout E. de Vries and Ard J. Barends for their help in evaluating the charisma manipulations.

References

Antonakis, J., Bastardoz, N., Jacquart, P., & Shamir, B. (2016). Charisma: An Ill-Defined and Ill-Measured Gift. *Annual Review of Organizational Psychology and Organizational Behavior, 3*(1), 293–319. https://doi.org/10.1146/annurev-orgpsych-041015-062305.

Antonakis, J., d'Adda, G., Weber, R. A., & Zehnder, C. (2021). "Just Words? Just Speeches?" On the Economic Value of Charismatic Leadership. *Management Science, 68*(9), 6355–6381. https://doi.org/10.1287/mnsc.2021.4219.

Antonakis, J., Fenley, M., & Liechti, S. (2011). Can Charisma Be Taught? Tests of Two Interventions. *Academy of Management Learning & Education, 10*(3), 374–396. https://doi.org/10.5465/amle.2010.0012.

Awamleh, R., & Gardner, W. L. (1999). Perceptions of leader charisma and effectiveness. *The Leadership Quarterly, 10*(3), 345–373. https://doi.org/10.1016/S1048-9843(99)00022-3.

Bastardoz, N., & van Vugt, M. (2019). The nature of followership: Evolutionary analysis and review. *The Leadership Quarterly, 30*(1), 81–95. https://doi.org/10.1016/j.leaqua.2018.09.004.

Bøggild, T. (2020). Cheater detection in politics: Evolution and citizens' capacity to hold political leaders accountable. *The Leadership Quarterly, 31*(2). https://doi.org/10.1016/j.leaqua.2018.09.006 101268.

Boyatzis, R. E. (2011). Neuroscience and Leadership: The Promise of Insights. *Ivey Business Journal*. Retrieved from https://iveybusinessjournal.com/publication/neuroscience-and-leadership-the-promise-of-insights/

Cahill, L., & McGaugh, J. L. (1995). A Novel Demonstration of Enhanced Memory Associated with Emotional Arousal. *Consciousness and Cognition, 4*(4), 410–421. https://doi.org/10.1006/ccog.1995.1048.

Cheng, J. T. (2020). Dominance, prestige, and the role of leveling in human social hierarchy and equality. *Current Opinion in Psychology, 33*, 238–244. https://doi.org/10.1016/j.copsyc.2019.10.004.

Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences, 36*(3), 181–204. https://doi.org/10.1017/S0140525X12000477.

Conger, J. A., & Kanungo, R. N. (1987). Toward a Behavioral Theory of Charismatic Leadership in Organizational Settings. *Academy of Management Review, 12*(4), 637–647. https://doi.org/10.5465/amr.1987.4306715.

Conger, J. A., Kanungo, R. N., & Menon, S. T. (2000). Charismatic leadership and follower effects. *Journal of Organizational Behavior, 21*(7), 747–767. https://doi.org/10.1002/1099-1379(200011)21:7<747::AID-JOB46>3.0.CO;2-J.

Cosmides, L. (1989). The logic of social exchange: Has natural selection shaped how humans reason? Studies with the Wason selection task. *Cognition, 31*(3), 187–276. https://doi.org/10.1016/0010-0277(89)90023-1.

Costa, M. (2021). He Said, She Said: The Gender Double Bind in Legislator-Constituent Communication. *Politics & Gender, 17*(4), 528–551. https://doi.org/10.1017/S1743923X19000862.

Cowan, N. (1988). Evolving conceptions of memory storage, selective attention, and their mutual constraints within the human information-processing system. *Psychological Bulletin, 104*(2), 163–191. https://doi.org/10.1037/0033-2909.104.2.163.

Crum, A., & Phillips, D. J. (2015). Self-Fulfilling Prophesies, Placebo Effects, and the Social-Psychological Creation of Reality. In *Emerging Trends in the Social and Behavioral Sciences* (pp. 1–14). Wiley. https://doi.org/10.1002/9781118900772.etrds0296.

den Hartog, D. N., & Verburg, R. M. (1997). Charisma and rhetoric: Communicative techniques of international business leaders. *The Leadership Quarterly, 8*(4), 355–391. https://doi.org/10.1016/S1048-9843(97)90020-5.

Emrich, C. G. (1999). Context Effects in Leadership Perception. *Personality and Social Psychology Bulletin, 25*(8), 991–1006. https://doi.org/10.1177/01461672992511007.

Emrich, C. G., Brower, H. H., Feldman, J. M., & Garland, H. (2001). Images in Words: Presidential Rhetoric, Charisma, and Greatness. *Administrative Science Quarterly, 46*(3), 527–557. https://doi.org/10.2307/3094874.

Engel, A. K., Fries, P., & Singer, W. (2001). Dynamic predictions: Oscillations and synchrony in top–down processing. *Nature ReviewsNeurosci., 2*(10), 704–716. https://doi.org/10.1038/35094565.

Ensari, N., & Murphy, S. E. (2003). Cross-cultural variations in leadership perceptions and attribution of charisma to the leader. *Organizational Behavior and Human Decision Processes, 92*(1–2), 52–66. https://doi.org/10.1016/S0749-5978(03)00066-9.

Ernst, B. A., Banks, G. C., Loignon, A. C., Frear, K. A., Williams, C. E., Arciniega, L. M., ... Subramanian, D. (2021). Virtual charismatic leadership and signaling theory: A prospective meta-analysis in five countries. *The Leadership Quarterly, 101541*. https://doi.org/10.1016/J.LEAQUA.2021.101541.

Fest, S., Kvaløy, O., Nieken, P., & Schöttner, A. (2021). How (not) to motivate online workers: Two controlled field experiments on leadership in the gig economy. *Leadership Quarterly, 32*(6). https://doi.org/10.1016/j.leaqua.2021.101514 101514.

Gehring, W. J., Goss, B., Coles, M. G. H., Meyer, D. E., & Donchin, E. (1993). A Neural System for Error Detection and Compensation. *Psychological Science, 4*(6), 385–390. https://doi.org/10.1111/j.1467-9280.1993.tb00586.x.

Grabo, A., Spisak, B. R., & van Vugt, M. (2017). Charisma as signal: An evolutionary perspective on charismatic leadership. *The Leadership Quarterly, 28*(4), 473–485. https://doi.org/10.1016/j.leaqua.2017.05.001.

Grabo, A., & van Vugt, M. (2016). Charismatic leadership and the evolution of cooperation. *Evolution and Human Behavior, 37*(5), 399–406. https://doi.org/10.1016/j.evolhumbehav.2016.03.005.

Hall, R. J., & Lord, R. G. (1995). Multi-level information-processing explanations of followers' leadership perceptions. *The Leadership Quarterly, 6*(3), 265–287. https://doi.org/10.1016/1048-9843(95)90010-1.

Henrich, J., Chudek, M., & Boyd, R. (2015). The Big Man Mechanism: How prestige fosters cooperation and creates prosocial leaders. *Philosophical Transactions of the Royal Society B: Biological Sciences, 370*(1683), 20150013. https://doi.org/10.1098/rstb.2015.0013.

Holladay, S. J., & Coombs, W. T. (1993). Communicating Visions. *Management Communication Quarterly, 6*(4), 405–427. https://doi.org/10.1177/0893318993006004003.

Hollander, E. P. (1992). Leadership, followership, self, and others. *The Leadership Quarterly, 3*(1), 43–54. https://doi.org/10.1016/1048-9843(92)90005-Z.

House, R. (1977). A 1976 theory of charismatic leadership. In J. G. Hunt & L. L. Larson (Eds.), *Leadership: The cutting edge* (pp. 189–207). Carbondale: Southern Illinois University Press.

Howell, J. M., & Frost, P. J. (1989). A laboratory study of charismatic leadership. *Organizational Behavior and Human Decision Processes, 43*(2), 243–269. https://doi.org/10.1016/0749-5978(89)90052-6.

Jarosz, A. F., & Wiley, J. (2014). What Are the Odds? A Practical Guide to Computing and Reporting Bayes Factors. *The Journal of Problem Solving, 7*(1), 2–9. https://doi.org/10.7771/1932-6246.1167.

Johnson, S. K., Murphy, S. E., Zewdie, S., & Reichard, R. J. (2008). The strong, sensitive type: Effects of gender stereotypes and leadership prototypes on the evaluation of male and female leaders. *Organizational Behavior and Human Decision Processes, 106*(1), 39–60. https://doi.org/10.1016/j.obhdp.2007.12.002.

Joireman, J., Kamdar, D., Daniels, D., & Duell, B. (2006). Good citizens to the end? It depends: Empathy and concern with future consequences moderate the impact of a short-term time horizon on organizational citizenship behaviors. *Journal of Applied Psychology, 91*(6), 1307–1320. https://doi.org/10.1037/0021-9010.91.6.1307.

Jokisch, O., Iaroshenko, V., Maruschke, M., and Ding, H. (2018). Influence of Age, gender and sample duration on the charisma assessment of German speakers. *Proceedings 29th Conference on Electronic Speech Signal Process* (Ulm).

Kafashan, S., Sparks, A., Griskevicius, V., & Barclay, P. (2014). Prosocial Behavior and Social Status. In *The Psychology of Social Status* (pp. 139–158). New York: Springer. https://doi.org/10.1007/978-1-4939-0867-7_7.

Kirkpatrick, S. A., & Locke, E. A. (1996). Direct and indirect effects of three core charismatic leadership components on performance and attitudes. *Journal of Applied Psychology, 81*(1), 36–51. https://doi.org/10.1037/0021-9010.81.1.36.

Kubu, C. S. (2018). Who does she think she is? Women, leadership and the 'B'(ias) word. *The Clinical Neuropsychologist, 32*(2), 235–251. https://doi.org/10.1080/13854046.2017.1418022.

Laustsen, L., & Petersen, M. B. (2015). Does a competent leader make a good friend? Conflict, ideology and the psychologies of friendship and followership. *Evolution and Human Behavior, 36*(4), 286–293. https://doi.org/10.1016/j.evolhumbehav.2015.01.001.

Lindebaum, D., & Zundel, M. (2013). Not quite a revolution: Scrutinizing organizational neuroscience in leadership studies. *Human Relations, 66*(6), 857–877. https://doi.org/10.1177/0018726713482151.

Lord, R. G., & Emrich, C. G. (2000). Thinking outside the box by looking inside the box. *The Leadership Quarterly, 11*(4), 551–579. https://doi.org/10.1016/S1048-9843(00)00060-6.

Meslec, N., Curseu, P. L., Fodor, O. C., & Kenda, R. (2020). Effects of charismatic leadership and rewards on individual performance. *The Leadership Quarterly, 31*(6). https://doi.org/10.1016/j.leaqua.2020.101423 101423.

Novák-Tót, E., Niebuhr, O., & Chen, A. (2017). A Gender Bias in the Acoustic-Melodic Features of Charismatic Speech? *Interspeech, 2017*, 2248–2252. https://doi.org/10.21437/Interspeech.2017-1349.

Nussenbaum, K., Scheuplein, M., Phaneuf, C. v., Evans, M. D., & Hartley, C. A. (2020). Moving Developmental Research Online: Comparing In-Lab and Web-Based Studies of Model-Based Reinforcement Learning. *Collabra Psychology, 6*(1), 17213. https://doi.org/10.1525/collabra.17213.

Ohman, A., Flykt, A., Esteves, F., & Institute, K. (2001). Emotion Drives Attention: Detecting the Snake in the Grass. *Journal of Experimental Psychology: General, 130*(3), 466–478. https://doi.org/10.1037/AXJ96-3445.130.3.466.

Paris, L. D., Howell, J. P., Dorfman, P. W., & Hanges, P. J. (2009). Preferred leadership prototypes of male and female leaders in 27 countries. *Journal of International Business Studies, 40*(8), 1396–1405. https://doi.org/10.1057/jibs.2008.114.

Petaros, A., Čavka, M., Šuran, A., & Muzur, A. (2015). Historical and Social Evolution of the Healers' Charisma. *Collegium Antropologicum, 39*(4), 957–963.

Podsakoff, P. M., MacKenzie, S. B., Moorman, R. H., & Fetter, R. (1990). Transformational leader behaviors and their effects on followers' trust in leader, satisfaction, and organizational citizenship behaviors. *The Leadership Quarterly, 1*(2), 107–142. https://doi.org/10.1016/1048-9843(90)90009-7.

Podsakoff, P. M., & Podsakoff, N. P. (2019). Experimental designs in management and leadership research: Strengths, limitations, and recommendations for improving publishability. *The Leadership Quarterly, 30*(1), 11–33. https://doi.org/10.1016/j.leaqua.2018.11.002.

Posner, B. Z., & Kouzes, J. M. (1988). Relating Leadership and Credibility. *Psychological Reports, 63*(2), 527–530. https://doi.org/10.2466/pr0.1988.63.2.527.

Price, M. E., & van Vugt, M. (2014). The evolution of leader-follower reciprocity: The theory of service-for-prestige. *Frontiers in Human Neuroscience, 8*, 363. https://doi.org/10.3389/fnhum.2014.00363.

R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Reh, S., van Quaquebeke, N., & Giessner, S. R. (2017). The aura of charisma: A review on the embodiment perspective as signaling. *The Leadership Quarterly, 28*(4), 486–507. https://doi.org/10.1016/j.leaqua.2017.01.001.

Rock, D., & Schwartz, J. (2006). The neuroscience of leadership. *Strategy + Business, 43*, 72–82.

Sauter, M., Draschkow, D., & Mack, W. (2020). Building, Hosting and Recruiting: A Brief Introduction to Running Behavioral Experiments Online. *Brain Sciences, 10*(4), 251. https://doi.org/10.3390/brainsci10040251.

Schjoedt, U., Sørensen, J., Nielbo, K. L., Xygalatas, D., Mitkidis, P., & Bulbulia, J. (2013). Cognitive resource depletion in religious interactions. *Religion, Brain & Behavior, 3*(1), 39–55. https://doi.org/10.1080/2153599X.2012.736714.

Schjoedt, U., Stødkilde-Jørgensen, H., Geertz, A. W., Lund, T. E., & Roepstorff, A. (2011). The power of charisma—perceived charisma inhibits the frontal executive network of believers in intercessory prayer. *Social Cognitive and Affective Neuroscience, 6*(1), 119–127. https://doi.org/10.1093/scan/nsq023.

Schlamp, S., Gerpott, F. H., & Voelpel, S. C. (2019). Same Talk, Different Reaction? Emergent Leadership, Task-Oriented Behavior, and the Role of Gender. *Academy of Management Proceedings, 2019*(1), 15845.

Shamir, B., Arthur, M. B., & House, R. J. (1994). The rhetoric of charismatic leadership: A theoretical extension, a case study, and implications for research. *The Leadership Quarterly, 5*(1), 25–42. https://doi.org/10.1016/1048-9843(94)90004-3.

Shamir, B., House, R. J., & Arthur, M. B. (1993). The Motivational Effects of Charismatic Leadership: A Self-Concept Based Theory. *Organization Science, 4*(4), 577–594. https://doi.org/10.1287/orsc.4.4.577.

Shamir, B., Zakay, E., Breinin, E., & Popper, M. (1998). Correlates of Charismatic Leader Behavior in Military Units: Subordinates' Attitudes, Unit Characteristics, And Superiors' Appraisals of Leader Performance. *Academy of Management Journal, 41*(4), 387–409. https://doi.org/10.5465/257080.

Sperber, D. (2010). The Guru Effect. *Review of Philosophy and Psychology, 1*(4), 583–592. https://doi.org/10.1007/s13164-010-0025-0.

Stadtler, M., Scharrer, L., Brummernhenrich, B., & Bromme, R. (2013). Dealing With Uncertainty: Readers' Memory for and Use of Conflicting Information From Science Texts as Function of Presentation Format and Source Expertise. *Cognition and Instruction, 31*(2), 130–150. https://doi.org/10.1080/07370008.2013.769996.

Stewart-Williams, S., & Podd, J. (2004). The Placebo Effect: Dissolving the Expectancy Versus Conditioning Debate. *Psychological Bulletin, 130*(2), 324–340. https://doi.org/10.1037/0033-2909.130.2.324.

Tosi, H. L., Misangyi, V. F., Fanelli, A., Waldman, D. A., & Yammarino, F. J. (2004). CEO charisma, compensation, and firm performance. *The Leadership Quarterly, 15*(3), 405–420. https://doi.org/10.1016/j.leaqua.2004.02.010.

van Doorn, J., van den Bergh, D., Böhm, U., Dablander, F., Derks, K., Draws, T., ... Wagenmakers, E.-J. (2021). The JASP guidelines for conducting and reporting a Bayesian analysis. *Psychonomic Bulletin & Review, 28*(3), 813–826. https://doi.org/10.3758/s13423-020-01798-5.

van Knippenberg, D., & Sitkin, S. B. (2013). A Critical Assessment of Charismatic—Transformational Leadership Research: Back to the Drawing Board? *Academy of Management Annals, 7*(1), 1–60. https://doi.org/10.5465/19416520.2013.759433.

van Vugt, M. (2006). Evolutionary Origins of Leadership and Followership. *Personality and Social Psychology Review, 10*(4), 354–371. https://doi.org/10.1207/s15327957pspr1004_5.

van Vugt, M., Hogan, R., & Kaiser, R. B. (2008). Leadership, followership, and evolution: Some lessons from the past. *American Psychologist, 63*(3), 182–196. https://doi.org/10.1037/0003-066X.63.3.182.

van Vugt, M., & Smith, J. E. (2019). A Dual Model of Leadership and Hierarchy: Evolutionary Synthesis. *Trends in Cognitive Sciences, 23*(11), 952–967. https://doi.org/10.1016/j.tics.2019.09.004.

Vlachos, P. A., Panagopoulos, N. G., & Rapp, A. A. (2013). Feeling Good by Doing Good: Employee CSR-Induced Attributions, Job Satisfaction, and the Role of Charismatic Leadership. *Journal of Business Ethics, 118*(3), 577–588. https://doi.org/10.1007/s10551-012-1590-1.

Waldman, D. A., Balthazard, P. A., & Peterson, S. J. (2011). Leadership and Neuroscience: Can We Revolutionize the Way That Inspirational Leaders Are Identified and Developed? *Academy of Management Perspectives, 25*(1), 60–74. https://doi.org/10.5465/amp.25.1.60.

Weber, M. (1968). *On charisma and institution building*. University of Chicago Press.

Williams, R., Jr, Raffo, D. M., & Clark, L. A. (2018). Charisma as an attribute of transformational leaders: What about credibility? *Journal of Management Development, 37*(6), 512–524. https://doi.org/10.1108/JMD-03-2018-0088.

Wolfram, H.-J., & Gratton, L. (2014). Gender Role Self-Concept, Categorical Gender, and Transactional-Transformational Leadership. *Journal of Leadership & Organizational Studies, 21*(4), 338–353. https://doi.org/10.1177/1548051813498421.

Yang, X., & Krajbich, I. (2020). Webcam-based online eye-tracking for behavioral research [Preprint]. *PsyArXiv*. https://doi.org/10.31234/osf.io/qhme6.