Co-designing get-out-the-vote messaging with youth increases message effectiveness

Kirsten Lydic[1], Omaya Torres-Grillo[1], Julia Levine[2,3], Sophia Lee[2,3], Paula Vekker[2,3], Pètra de Beer[2,3], Lyan Casamalhuapa[2,3], Alyssa Sinclair[1,4], Emily B. Falk[1,4,5,6], Danielle Cosme[1,4]

Corresponding authors: Kirsten Lydic (kolydic@upenn.edu), Danielle Cosme (dcosme@falklab.org)

1 Annenberg School for Communication, University of Pennsylvania, Philadelphia, USA
2 School of Arts and Sciences, University of Pennsylvania, Philadelphia, USA
3 Penn Leads the Vote, University of Pennsylvania, Philadelphia, USA
4 Annenberg Public Policy Center, University of Pennsylvania, Philadelphia, USA
5 Department of Psychology, University of Pennsylvania, Philadelphia, USA
6 Wharton Business School, University of Pennsylvania, Philadelphia, USA

CRediT (modified)

Conceptualization - all; Data collection carried out by - D.C., O.T.G.; Study design - all; Message conceptual design - all; Message graphic design - O.T.G.; Data analysis conducted by - K.L., D.S., J.L., P.d.B.; Data interpretation - all; Funding - D.C. and E.B.F.; Project admin - D.C., O.T.G.; Resources - E.B.F.; Supervision - D.C.; Visualization - D.C., O.T.G. ,K.L.; Writing initially - all; Writing completion - D.C., K.L.; Reviewing and editing - all.

Abstract

Voting is a critical component of representative democracy but yields consistently low engagement from young Americans. Online communication interventions have the potential to catalyze action, but evidence regarding best practices for digital, youth-focused get-out-the-vote (GOTV) messaging is sparse. Guided by the Theory of Planned Behavior and Reasoned Action approaches, we integrated formative and participatory research approaches to fill this gap. In a partnership between communication researchers and a college student-led GOTV organization, we conducted formative research integrating experiential knowledge from youth partners with scientific evidence to generate a set of voting beliefs. We used the standard Hornik & Woolf method to select promising beliefs to target in messaging but also conducted post-hoc analyses demonstrating the potential of network approaches that take into account relationships among beliefs to identify influential beliefs. We then co-designed belief-informed GOTV messages that could be disseminated via social media and tested message effects in both local and national samples of college students. We found that the messages co-designed with youth to target promising voting beliefs were more motivating, persuasive, and self-relevant than existing GOTV social media messages from a national youth-focused campaign. They were also more motivating and persuasive than prior messages from our student-led GOTV partner organization—which were not designed using formative research—suggesting that the combination of formative and participatory research practices increases message effectiveness. Overall, these studies highlight the importance of engaging youth in voting research and illustrate the benefits of integrating theory-based formative research, network approaches, and human-centered participatory practices to develop messaging campaigns.

Keywords: voting, message effects, beliefs, theory of planned behavior, participatory action research

Introduction

In the U.S. and other representative democracies, voting is a crucial mechanism that enables citizens to express opinions and influence political outcomes. However, approximately one in five eligible voters in the United States is not registered to vote (Pew, 2022). Out of all age groups, youth and young adults aged 18-29 also tend to have the lowest turnout (Pew, 2023a). Despite lower voting turnout, they are not apathetic (CIRCLE, 2025a). Youth express high levels of concern about political issues (Pew, 2018; Martin, 2012; Pew, 2023b), have a degree of interest in political issues comparable to older generations (Holbein and Hillygus 2020; Bergan et al., 2021), and engage in other political behaviors such as boycotting/buycotting, signing petitions, or attending protests and demonstrations (Zukin et al., 2006; CIRCLE, 2023a). This highlights the potential to leverage communication interventions to convert political interest into motivation to vote. Indeed, numerous nonprofit organizations, such as *Rock the Vote* and *NextGen America*, are focused solely on registering and turning out youth to vote. Given their digital nativity (Teo, 2013), messaging strategies can reach youth through social media and other online resources (Delli Carpini, 2000). However, scientific evidence is sparse regarding what communication interventions are most effective for youth, particularly on social media. We address this gap using a fully collaborative, participatory action research approach in partnership with youth to design theory-based, youth-focused GOTV messages that can be disseminated on social media.

Youth voting

Youth and young adults aged 18-29 consistently have lower voting turnout than older adults (Pew, 2023a; Bergan et al., 2021). A commonly cited barrier for youth is a sense of having insufficient knowledge or information about the registration and voting process or candidates and issues (Knoester & Kretz, 2017; Knoester & Gichiru, 2021; Kawashima-Ginsburg and Kiesa, 2019; Bergan et al., 2021; CIRCLE, 2023a). However, psychological and social factors such as self-efficacy, political efficacy, civic duty, social norms, or affiliation with a social movement also affect motivation to vote in youth (Knoester & Kretz, 2017; Kawashima-Ginsburg & Kiesa, 2019; CIRCLE, 2022; Apau et al., 2025; Levy & Akiva, 2019; Condon & Holleque, 2013; Glynn et al., 2009; Bergan et al., 2021; Lydic et al., 2025).

Prior research has explored a variety of strategies to increase youth voting, including informational and civic education interventions (Feldman et al., 2007; McDevitt & Chaffee, 2000; Syvertsen et al., 2009; Bergan et al., 2021; Bennion and Nickerson, 2016; Haenschen & and Jennings, 2019), events that aim to foster political socialization (Howard & Posler, 2012; Bennion & Michelson, 2023), and voting pledge campaigns (Costa et al. 2018; Bergan et al., 2021; Burgess et al., 2000). Many of these interventions have been implemented on college campuses, where there is a unique proximity to youth and resources to organize GOTV activities (Bennion & Michelson, 2023). However, these campus-based campaigns can be difficult to scale, and there has been relatively less research on mass communication interventions to increase youth turnout.

GOTV communication research has demonstrated that media efforts can support youth voting, but the effects are often small and findings are inconsistent across studies. Impersonal, mass media messages have particularly inconsistent effects. For example, *Rock the Vote* television ads, which target young voters, have been considered both effective and cost-competitive methods for increasing youth turnout (Green & Vavreck, 2006). On the other hand, *Rock the Vote* spent more money on these ads with less impact than other campaigns at the time, and did not address the most frequent barriers reported by youth (Richards, 2012; Orr & Hoover, 2007). Prior work has also shown mixed results about the role of subtle linguistic cues in GOTV messaging. For example, in majority young-adult samples, - Bryan et al. (2011) found that “invoking the self” by framing voting questions around a sense of identity (“being a voter”) was more effective than framing questions around the behavior itself (“voting”), though this intervention was less effective in other studies including older adults (Gerber et al., 2016).

Beyond mixed evidence regarding which message frames are most effective, Nickerson (2006) found that GOTV efforts can be as effective for youth (18-24) as older adults, but that youth are harder to contact via phone or door-to-door canvassing. Indeed, youth are contacted less frequently than older adults before elections (CIRCLE, 2022). Thus, strategies that adopt youths' preferred communication systems could yield greater reach, highlighting the necessity for more research on messaging campaign design, delivery, and impact in online spaces. Employing social media as a dissemination tool for GOTV messaging campaigns, Teresi & Michelson (2015) found that GOTV messages delivered through online social networks can increase turnout in college students. However, Unan et al. (2024) found null effects of social media messaging campaigns on young voter (aged 18-35) registration across three studies in the U.K. Prior work has thus yielded inconclusive evidence for best practices in GOTV social media communication efforts. Additionally, researchers and practitioners alike could better engage youth in the development of messaging campaigns. Prior qualitative evaluation of youth-led GOTV efforts highlights their potential for success (Jameson-Charles & Charles, 2022), but quantitative evidence is lacking.

GOTV campaign development

Borrowing from theories of health messaging campaign development (Fishbein & Ajzen, 2010), we argue that GOTV communication strategies may be more effective if campaigns address the beliefs about voting that are most malleable and most likely to lead to action if successfully targeted by persuasive messaging. That is, real-world GOTV messaging can benefit from integrating theories of behavior change, such as the Theory of Planned Behavior, which centers behavioral, normative, and control beliefs as targets for behavior change (Fishbein & Ajzen, 2010; Ajzen, 1991; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975).

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) proposes that intentions and behavior are shaped by upstream beliefs about the behavior (behavioral beliefs), how normative it is (normative beliefs), and one's ability to engage in the behavior (control beliefs). Prior research has identified numerous classes of beliefs that are associated with voting intentions and behavior. With respect to behavioral beliefs, individuals are more likely to vote if they view voting as their personal (Bali et al., 2020), civic (Lydic et al., 2025; Harder & Krosnick, 2008), or moral duty (Blais & Daoust, 2020); see voting as important to them personally (Knoester & Kretz, 2017); have high political interest (Levy & Akiva, 2019); expect the outcome of the election to benefit themselves (Bali et al., 2020); and anticipate experiencing positive or negative emotions as a result of the election (Knight & Peterson, 2022). Having high trust in government or faith in the political system (CIRCLE, 2023a; Kawashima-Ginsburg & Kiesa, 2019; Apau et al., 2025) and believing that it is responsive to the public (i.e., external political efficacy; Harder & Krosnick, 2008) are also positively associated with voting. Normative beliefs that voting can promote solidarity (Harder & Krosnick, 2008) and belonging (Bali et al., 2020), and is engaged in by in-group members (Glynn et al., 2009; Bergan et al., 2021) are also positively associated with voting. Control beliefs related to political efficacy and self-efficacy (Condon & Holleque, 2013; Harder & Krosnick, 2008), having civic knowledge and skills (Maiello et al., 2003), ease of registration and voting (Harder & Krosnick, 2008), and knowledge about candidates and ballot measures (Knoester & Kretz, 2017; Knoester & Gichiru, 2021; Kawashima-Ginsburg and Kiesa, 2019; Bergan et al., 2021; CIRCLE, 2022) are also associated with whether individuals vote. Although prior work has shown that many of these beliefs are relevant in youth voting (Knight & Peterson, 2022; Lydic et al., 2025; Kawashima-Ginsburg & Kiesa, 2019; Apau et al., 2025; Glynn et al., 2009; Bergan et al., 2021; Condon & Holleque, 2013; Knoester & Kretz, 2017; Knoester & Gichiru, 2021; CIRCLE, 2022; Levy & Akiva, 2019), there has not been a systematic examination of these beliefs among college students to determine which beliefs might be most effectively targeted in

messaging campaigns. Prior work has applied TPB to voting intentions and behavior in young adults (Glasford, 2008), but this study did not examine specific beliefs about voting. Moreover, extant research on voting beliefs does consider the relative strengths of associations between beliefs and voting intentions and behavior.

To identify voting beliefs among youth that can be targeted in messaging campaigns with the greatest potential impact, preliminary (formative) research on a broad range of specific behavioral beliefs is needed. Formative research is a preliminary research procedure to gather insights from the target population in order to inform messaging campaign or intervention design and tailoring (Capella, 2006; Martinez et al., 2012; Pleasant et al., 2020). Formative research practices solicit voices from the target population to direct intervention design towards changing particular beliefs that show the strongest relationships with the target behavior. Conducting formative research increases the success of interventions (Pleasant et al., 2020) and provides opportunities for the target population to inform the problem definition and offer nuanced perspectives on what motivates (or demotivates) their behavior.

Identifying promising beliefs through formative research

There is robust evidence from public health campaign research that designing messages to target promising beliefs, identified through formative research, is an effective way to shift behavioral intentions (Hornik and Woolfe, 1999; Hornik et al., 2018; Fishbein and Cappella, 2006). Reasoned Action models of behavior change, such as TPB, posit that behavior stems from a network of beliefs that shape attitudes about the behavior, which in turn influence intentions and subsequent behavior (Fishbein and Ajzen, 2010; Ajzen, 1991; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Promising beliefs are those that are strongly associated with intentions to engage in a target behavior—in this case, voting—and can distinguish between people who do and do not intend to engage in the behavior. Crucially, promising beliefs should not already be widely held by the target population so that interventions have room to move beliefs (i.e., avoiding ceiling effects). By targeting promising beliefs, messaging interventions can increase belief strength, which in turn can increase intentions and behavior (Hornik and Woolfe, 1999; Hornik et al., 2018; Fishbein and Cappella, 2006). Although this approach is widely used in the field of health communication (Pleasant et al., 2020; Hornik et al., 2018), it has not yet been adopted to design GOTV messages. Although promising beliefs have been shown to be more strongly predictive of future behavior change than other beliefs (Hornik et al., 2018), messages targeting less promising beliefs can still induce positive effects if they are correlated with more promising beliefs (Lee et al., 2016). Therefore, it is also important to consider the relationships among beliefs when designing campaigns.

Recent research in political psychology and communication has applied network approaches to study relationships among beliefs (Brant & Sleegers, 2021; Vlasceanu et al., 2024). Psychological network approaches to understanding belief systems conceptualize beliefs as nodes in a network and the relationships between beliefs as edges connecting nodes. By constructing belief networks in this way, graph theory methods can be applied to understand network properties, how they differ among individuals and groups (Brandt, 2022; Brandt & Sleegers; 2021; Vlasceanu et al., 2024), and how messaging (Keating, 2024) and other interventions can shift attitudes and behavior by targeting beliefs to induce changes in the network (Brant & Sleegers, 2021; Turner-Zwinkels & Brant, 2022; Vlasceanu et al., 2023). Examining the interrelationships among beliefs using network methods also has the potential to help researchers to identify beliefs with relatively stronger influence on the network that would make them promising intervention targets. As such, measures of network centrality—which index the relative importance and influence of nodes within a network based on their location and connections—may represent a complementary approach to identifying promising beliefs in formative research.

Youth participatory action research

Whereas traditional methods of formative research typically have limited engagement with the target population, participatory action research engages communities in deeper ways. Youth participatory action research (YPAR) is a research framework that engages youth in the process of problem identification; research design, implementation, and interpretation; and taking action to address the identified problem (Ozer et al., 2024, Ozer & Piatt, 2018; Cornish et al., 2023). Beyond the aim of producing knowledge through research, a primary goal of YPAR is to empower youth to identify and interrogate issues they are affected by, and develop and enact solutions to address them (Ozer et al., 2024; Ozer & Piatt, 2018). A guiding principle of YPAR is that youth are experts on their own experiences and can contribute meaningfully to the research process, and researchers can support youth to develop civic and research skills in the process (Cornish et al., 2023, Ozer et al., 2024). As a co-design process, YPAR provides a deeper opportunity to uplift youth voices in communication intervention and campaign development, where youth can offer their own expertise about what motivates and hinders them.

Though YPAR has been implemented to address a broad array of youth-relevant issues (Anyon et al., 2018), it has only recently begun to be applied in communication research. Recent research in health communication has demonstrated that formative research, message design, and message testing can be carried out with and benefit from a YPAR approach (Kikut-Stein et al., 2024; Kikut-Stein et al., 2025). In the present studies, we expand the YPAR-communication framework laid out in Kikut-Stein et al. (2024, 2025) to the domain of voting research, across all stages of campaign design.

The current studies

Prior evidence underscores the need for effective, evidence-based messaging strategies to motivate youth voting. We address this gap using a participatory approach that involved youth in all stages of a research process to create youth-focused GOTV messages to motivate voting on our local college campus during the 2024 general election. The study team included members of a communication research lab as well as members of a student-led, nonpartisan GOTV organization on campus, *Penn Leads the Vote* (PLTV). Across three studies, we conducted formative research to map voting beliefs among youth (18-25 year olds) and identify promising beliefs (Study 1). In addition to using the standard Hornik & Woolf method (1999) to select promising beliefs, we also applied a novel network approach that considers relationships among beliefs to identify influential beliefs. We then co-designed GOTV messages targeting these promising beliefs (Study 2) and evaluated how effective the co-designed messages were compared to existing GOTV messages from local and national campaigns (Study 3). This work represents a novel integration of theory-driven formative research and participatory practices to design GOTV messages for youth, *with* youth.

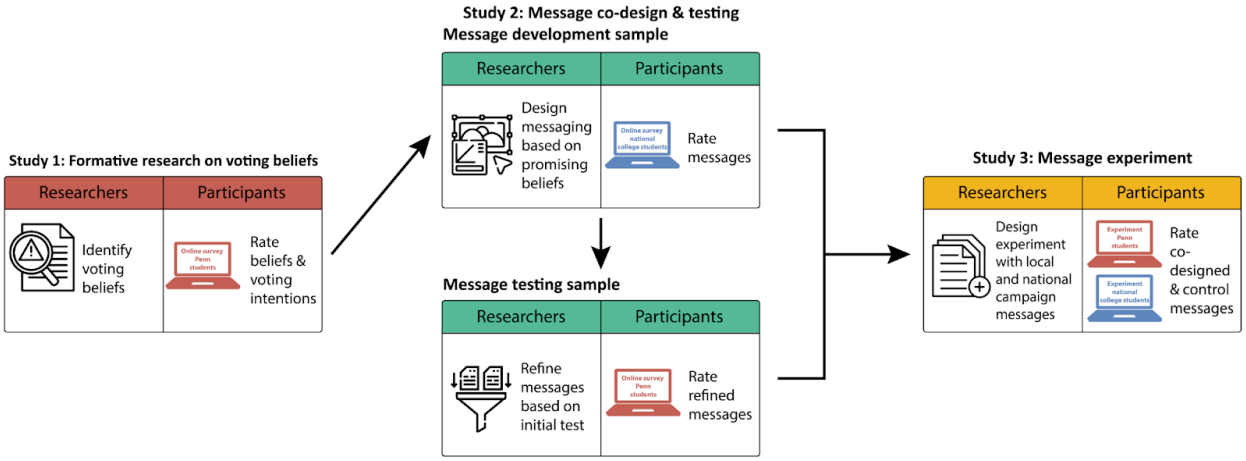

Figure 1. Overview of research process across Studies 1, 2, and 3 describing researchers and participants activities. "Researchers" includes both research lab members and PLTV youth research partners; "Participants" are college students who completed online studies.

Study 1: Formative research on voting beliefs

In this study, we conducted survey research to identify promising beliefs about voting among college students that could be targeted in social media messages in subsequent studies. Although we used the Hornik & Woolf method to select promising beliefs during the 2024 election season, we also conducted post-hoc network analyses to examine the relationships among beliefs and explore centrality as a complementary method for promising belief identification.

Methods

Participants

Participants were recruited through listservs of undergraduate majors (n = 136) and through the Human Subjects Pool at the University of Pennsylvania (n = 184) in late August and early September 2024. Inclusion criteria were as follows: current Penn students, aged 18+ years, fluent in English, and eligible to vote in the November 2024 U.S. general election. Given that youth were our target audience, participants who were older than 25 were ultimately excluded from analysis (n = 46). This resulted in a total of 274 participants who were aged 18-25 (M = 20.1, SD = 1.4). Participants self-reported the following gender identities: 23.4% men, 74.1% women, 0.4% genderqueer, 0.4% non-binary, 1.5% preferred not to say, and 0.4% preferred to self-describe. With respect to race and ethnicity, participants identified as the following: 46.4% White, 22.4% East Asian, 10.2% Black or African American, 5.8% South Asian, 7.8% Southeast Asian, 2.0% Middle Eastern or North African, 0.3% American Indian or Alaskan Native, 0.7% Native Hawaiian or Other Pacific Islander, and 1.4% other racial/ethnic identity not listed. 8.3% of participants also identified as Hispanic or Latina/o/x. This study was approved by the University of Pennsylvania Institutional Review Board and participants gave informed consent. Participants were compensated for participation via a $5 Amazon gift card or course credit for completing a 15-minute survey.

Belief identification

We generated a set of initial beliefs by identifying factors that may motivate people to vote, values and beliefs related to voting, and barriers that may make it difficult to vote. During this generation phase, we drew from the existing literature on voting behavior reviewed above, prior studies conducted

by our team members (Lydic et al., 2025; Cosme et al., 2023), our personal experiences, and youth team members' conversations with peers about voting. In total, we generated 37 beliefs that we expected may be positively or negatively related to voting intentions. Example beliefs and associated themes are listed in Table 1 and all beliefs are listed in Table S1.

Table 1

Example beliefs tested in the formative research survey in Study 1

Theme	Text	Valence
Self-efficacy	It's too difficult or effortful to find out how to register to vote	Negative
Belonging	Voting makes me feel like I'm part of a community	Positive
Self-relevance	Voting is consistent with my core values	Positive
Instrumentality	Voting can contribute to building a better world	Positive
Response efficacy	Even if I vote, nothing will change for people like me	Negative
Personal impact	The outcome of the election will affect my rights and freedoms	Neutral
Social impact	There is a lot at stake for people I care about in the election	Neutral

Procedure

Eligible participants completed an online survey administered via Qualtrics. After consenting, participants were presented with 37 belief statements (Table S1). For each statement, participants used a 7-point Likert-type scale to indicate their agreement, ranging from 1 = "Strongly Disagree" to 7 = "Strongly Agree," capturing participants' endorsement of each belief. Participants then completed a series of questionnaires designed to evaluate their attitudes, intentions, behaviors, and motivations regarding voting and civic engagement. Participants responded to 10 items based on the Theory of Planned Behavior (Ajzen, 1991) to assess intention to vote ("I plan to vote in the 2024 general election"; 1 = "Definitely not" to 7 = "Definitely yes") as well as intentions to register and make a plan, attitudes, norms, perceived behavioral control, and past voting behaviors. Correlations between beliefs and these additional measures are included in Supplementary Material (Table S4). Participants also completed additional measures of motivation, civic engagement, and civic attitudes that are not the focus of the present study. After completing these measures, participants responded to demographic questions and were provided with an opportunity to give feedback through an open-response question.

Statistical analysis

Promising beliefs

We used the Hornik & Woolf method (1999) to identify promising beliefs. We dichotomized the continuous measures of intentions to vote by categorizing people who selected "strongly agree" as "intenders" and people who selected any other option as "non-intenders." We followed a similar approach with the belief strength variables; beliefs for which participants selected "strongly (dis)agree" were recoded as "strong" beliefs, whereas beliefs for which any other values were selected were recoded as "weak" beliefs. Using these cross-tabs, we calculated the *percentage to gain* for each belief. Percentage to gain was calculated by subtracting the total percentage of people who intend to vote from the percentage of people who intend to vote and strongly endorse the belief. An example of this calculation is provided in Table 2 (97.8% - 70.3% = 27.5% to gain). In addition to calculating the percentage to gain for each belief, we calculated the mean difference in continuous (i.e., non-dichotomized) belief strength for intenders and non-intenders, the correlation between continuous belief strength and intentions to vote, and the *percentage to move*, which reflects the number of people who do not strongly hold a belief. Higher values indicate greater potential for messaging campaigns to shift beliefs.

Table 2
Example of percentage to gain calculation for the belief "Voting is consistent with my core values"

	Weak belief	Strong belief	Total
Non-intender	79 (43.6%)	2 (2.2%)	81 (29.7%)
Intender	102 (56.4%)	**90 (97.8%)**[a]	**192 (70.3%)**[b]
Total	181 (100.0%)	92 (100.0%)	273 (100.0%)

Note. Percentage to gain is calculated per belief by subtracting the percentage of the sample that are intenders (denoted as *b*) from the percentage of the sample that are intenders *and* hold a given belief strongly (denoted as *a*).

Belief network

In post-hoc analyses, we explored the structure of the relationships among beliefs using a network approach. Specifically, we estimated a Gaussian Graphical Model—an undirected network of partial correlations—using the graphical LASSO (GLASSO) regularization algorithm (Friedman et al., 2008) to obtain a sparse network implemented in the *qgraph* package (Epskamp et al., 2012). We chose this method because simulation studies indicate that this method can recover the true underlying network structures with high sensitivity (Fried & Eskamp, 2018) and has been used in previous studies examining belief networks (Turner-Zwinkels et al., 2022). We also explored how beliefs clustered together using community detection methods. We applied an agglomerative walktrap algorithm from the *igraph* package (Csárdi, 2021) to identify densely connected communities using random walks (Pons & Latapy, 2005). We selected this algorithm given its ability to accurately recover network communities (Hoffman et al., 2017) and its use in studying belief networks (Quintana, 2023; Turner-Zwinkels et al., 2021; 2022).

From this network, we calculated the eigenvector centrality for each belief node as a measure of centrality. To validate centrality as a metric to compare and identify promising beliefs, we examined the correlation between node centrality and the average correlation between the belief and voting intention. We focused on eigenvector centrality as a measure of centrality because it reflects not only the number of connections but how influential connections are, reflecting greater potential impact if targeted. Furthermore, while researchers should use caution when inferring causal importance from centrality measures, eigenvector centrality predicts the actual causal influence of nodes reasonably well (Dablander & Hinne, 2019). Correlational values were Fisher z-transformed and the absolute value was used since eigenvector centrality does not take into account the sign of relationships.

Results

Correlations with voting intentions

All beliefs showed statistically significant correlations with intention to vote and statistically significant mean differences between intenders and non-intenders. Negative correlations ranged from *r* = -.71 ("Voting is not important to me") to *r* = -.26 ("Not voting is a form of self-expression") and positive correlations ranged from *r* = .35 ("Voting makes me feel connected to others") to *r* = .58 ("Voting is relevant to me personally"). Correlations for promising beliefs with >20% to gain (see below) are reported in Table 3; correlations for all beliefs are reported in Supplementary Table S3.

Percentage to move

The most common strongly held beliefs (i.e., beliefs participants strongly agreed or strongly disagreed with) were "voting is my right" (percentage to move = 28.5) and "the outcome of the election will impact the future of our country" (percentage to move = 43.8). All other beliefs were strongly held by less than half of the sample (Table S2), indicating substantial room to move.

Percentage to gain

Percentage to gain ranged from 11.2%-28.5%, and 29 beliefs had percentage to gain values >20%, which we used as a threshold to identify "promising beliefs" to target in messaging. Four of the top five most promising beliefs were related behavioral beliefs related to the self ("Voting is consistent with my core values", "Voting is not important to me") and disillusionment ("It doesn't matter if I personally vote", "The system is too broken to be fixed by voting"). Percentage to gain values and descriptive statistics for the promising beliefs are reported in Table 3 and for the remaining beliefs in Supplementary Table S3.

Table 3

Beliefs, mean differences between groups (intenders and non-intenders), correlation between belief strength and voting intentions, percentage of people with strong voting intentions in each group, and the percentage to gain

Belief text	M_{diff} [95% CI]	*r* [95% CI]	$\%_{intender}$	$\%_{non\text{-}intender}$	$\%_{gain}$
It doesn't matter if I personally vote*	-2.04 [-2.40, -1.69]	-0.61 [-0.68, -0.53]	98.9	1.1	28.5
Voting is consistent with my core values	1.41 [1.09, 1.73]	0.55 [0.47, 0.63]	97.8	2.2	27.4
The system is too broken to be fixed by voting*	-1.30 [-1.71, -0.89]	-0.36 [-0.46, -0.25]	97.5	2.5	27.1
Voting is not important to me*	-1.89 [-2.22, -1.55]	-0.71 [-0.77, -0.65]	97.4	2.6	27.0
It's too difficult or effortful to find out how to register to vote*	-1.48 [-1.85, -1.11]	-0.35 [-0.45, -0.24]	96.6	3.4	26.2
Voting is relevant to me personally	1.67 [1.29, 2.05]	0.58 [0.50, 0.66]	96.1	3.9	25.7
It's too difficult or effortful to make a plan to vote*	-1.42 [-1.75, -1.09]	-0.41 [-0.50, -0.30]	95.7	4.3	25.3
Voting makes me feel like I'm part of a community	1.19 [0.79, 1.60]	0.40 [0.30, 0.50]	95.6	4.4	25.2
There is a lot at stake for me personally in the election	1.40 [0.98, 1.81]	0.41 [0.31, 0.51]	95.5	4.5	25.1
Voting makes me feel connected to others	1.09 [0.69, 1.50]	0.35 [0.24, 0.45]	95.3	4.7	24.9
Even if I vote, nothing will change for people like me*	-1.24 [-1.65, -0.83]	-0.41 [-0.51, -0.31]	94.2	5.8	23.8
Voting allows me to be a part of something bigger than myself	1.24 [0.88, 1.60]	0.51 [0.42, 0.59]	94.1	5.9	23.7
The act of voting is important regardless of the outcome	1.34 [0.97, 1.72]	0.49 [0.39, 0.57]	94.1	5.9	23.7
It's too difficult or effortful to find out how cast my ballot (in person or by mail)*	-1.71 [-2.06, -1.35]	-0.45 [-0.54, -0.35]	94.0	6.0	23.6
Voting is my duty	1.58 [1.20, 1.95]	0.56 [0.47, 0.63]	93.9	6.1	23.5
Voting is a way I can advance the causes I care about	1.07 [0.75, 1.40]	0.42 [0.32, 0.51]	93.6	6.4	23.2
Voting is a way I can speak up for others	1.07 [0.70, 1.43]	0.37 [0.26, 0.47]	93.4	6.6	23.0
Because of where I live and vote, my vote doesn't matter*	-1.53 [-1.97, -1.08]	-0.43 [-0.52, -0.33]	93.1	6.9	22.7
The outcome of the election will impact my local community	1.24 [0.84, 1.63]	0.42 [0.32, 0.52]	92.9	7.1	22.5
Not voting is a form of self-expression*	-1.34 [-1.80, -0.89]	-0.26 [-0.37, -0.15]	92.7	7.3	22.3
There is a lot at stake for people I care about in the election	1.42 [1.04, 1.79]	0.51 [0.42, 0.60]	92.5	7.5	22.1
I am not qualified or knowledgeable enough to make decisions about items on the ballot*	-1.67 [-2.09, -1.25]	-0.46 [-0.55, -0.36]	92.4	7.6	22.0
Voting is a way I can express my voice about issues I care about	1.34 [0.98, 1.69]	0.49 [0.39, 0.57]	92.1	7.9	21.7
No one will care whether or not I vote*	-1.44 [-1.83, -1.05]	-0.45 [-0.54, -0.35]	91.9	8.1	21.5
Voting is an important part of being civically engaged	0.93 [0.66, 1.19]	0.43 [0.32, 0.52]	91.7	8.3	21.3
I don't think I will have time to vote*	-1.73 [-2.08, -1.38]	-0.50 [-0.59, -0.41]	91.7	8.3	21.3
I don't think I will have time to learn about what is on the ballot*	-1.57 [-1.98, -1.16]	-0.41 [-0.50, -0.31]	91.2	8.8	20.8
If I don't like the candidates, it's not worth voting*	-1.78 [-2.17, -1.38]	-0.53 [-0.61, -0.44]	90.6	9.4	20.2
Voting is relevant to people I know	1.16 [0.85, 1.47]	0.47 [0.37, 0.56]	90.4	9.6	20.0

Note. Negative beliefs (denoted by *) are only reverse-scored for the percent metrics (i.e. percent intenders and non-intenders, and percentage to gain).

Belief network

Network structure. Applying a community detection algorithm revealed a moderately modular structure (modularity = 0.47) with five clusters (Figure 1A) roughly corresponding to: (1) control beliefs (e.g., "It's too difficult to find out how to register to vote"), (2) normative beliefs about belonging (e.g., "Voting makes me feel like I'm part of a community"), (3) behavioral beliefs about the instrumentality of

voting (e.g., “Voting is a way I can express my voice about issues I care about”, “Voting is a way to contribute to building a better world”), (4) behavioral beliefs about the impact of the election and relevance of voting (e.g., “Voting impacts policies and outcomes I care about”, “Voting affects the rights and freedoms of people I care about”), and (5) negative behavioral beliefs (e.g., “If I don’t like the candidates, it’s not worth voting”) and beliefs related to the importance of voting (e.g., “It doesn’t matter if I personally vote”, “Voting is consistent with my core values”).

Descriptively examining the beliefs within each cluster revealed several interesting insights. First, the clusters containing control beliefs and normative beliefs about belonging each contained beliefs of a single type, whereas the other clusters contained a combination of normative and behavioral beliefs. Second, the latter clusters contained a mix of self-related (e.g., “There is a lot at stake for me personally”) and social behavioral beliefs (e.g., “There is a lot at stake for people I care about”). Third, self-related and social beliefs within these clusters were not segregated but were instead often tightly linked (e.g., “Voting will affect my rights and freedoms” and “Voting will impact my local community”). Fourth, although normative beliefs tended to be more strongly associated with other normative or social beliefs within these clusters, there were some surprisingly strong connections with self-related behavioral beliefs (e.g., “Voting is my duty” and “Voting is consistent with my core values”).

We quantified the number of connections between communities to examine their interrelationships and found substantial variability. Clusters 4 (behavioral beliefs about impact) and 5 (negative beliefs and beliefs about importance) had the most connections (n = 15), whereas clusters 4 and 2 (belonging beliefs), clusters 4 and 1 (control beliefs), and clusters 1 and 2 had no connections. Cluster 5 had connections to all other clusters ($n_{cluster\ 1}$ = 9, $n_{cluster\ 2}$ = 1, $n_{cluster\ 3}$ = 10), and Cluster 3 (instrumental beliefs) was moderately connected to other all clusters ($n_{cluster\ 1}$ = 5, $n_{cluster\ 2}$ = 5, $n_{cluster\ 4}$ = 7).

Belief centrality. Averaging across beliefs in each cluster, behavioral beliefs about the impact of the election and relevance of voting tended to be most central (*M* = 0.83; Figure 1B). Overall, “Voting is relevant to me personally” was the most central belief and numerous other beliefs associated with self-relevance (e.g., voting affecting one’s rights and freedoms, voting being consistent with one’s core values, voting not being personally important, etc.) also tended to be more central. Behavioral beliefs about the instrumentality of voting (*M* = 0.68), normative beliefs about belonging (*M* = 0.65) and behavioral beliefs about the importance of voting (*M* = 0.58), were less central, and control beliefs (*M* = 0.44) were the least central. In addition to control beliefs, negative behavioral beliefs related to disillusionment (e.g., “Not voting is a form of self-expression”, “The system is too broken to be fixed by voting”) tended to be the least central.

Association between belief centrality and correlation with intention to vote. Examining the relationship between belief node centrality and the mean absolute correlation between beliefs and voting intentions revealed a strong correlation (Figure 1C). Beliefs that were more central also tended to be more strongly correlated with intentions to vote ($r(35) = .62$, 95% CI [.37, .79], $t = 4.70$, $p < .001$).

Associations between belief centrality and percentage to move and to gain. In contrast to the correlations with intentions to vote, belief centrality was weakly negatively associated with percentage to move ($r(35) = -.20$, 95% CI [-.49, .13], $t = 1.20$, $p = .238$) but the relationship was not statistically significant. The correlation between belief centrality and percentage to gain was near zero ($r(35) = .03$, 95% CI [-.30, .35], $t = 0.17$, $p = .867$). Although centrality and percentage to gain were not correlated, we examined areas of correspondence between these two methods by identifying beliefs that were above average for both centrality and percentage to gain (Figure S1; Table 4).

Table 4
Beliefs with above average centrality and percentage to gain

Cluster	Belief text	Perspective
(2) Belonging	Voting makes me feel like I'm part of a community	Social

(3) Instrumentality	Voting is a way I can advance the causes I care about	Self-related
	Voting is a way I can speak up for others	Social
	Voting allows me to be a part of something bigger than myself	Social
(4) Impact	Voting is relevant to me personally	Self-related
	There is a lot at stake for me personally in the election	Self-related
	There is a lot at stake for people I care about in the election	Social
	The outcome of the election will impact my local community	Social
(5) Importance/negative	Voting is consistent with my core values	Self-related
	It doesn't matter if I personally vote	Self-related
	Voting is not important to me	Self-related
	Voting is my duty	Social

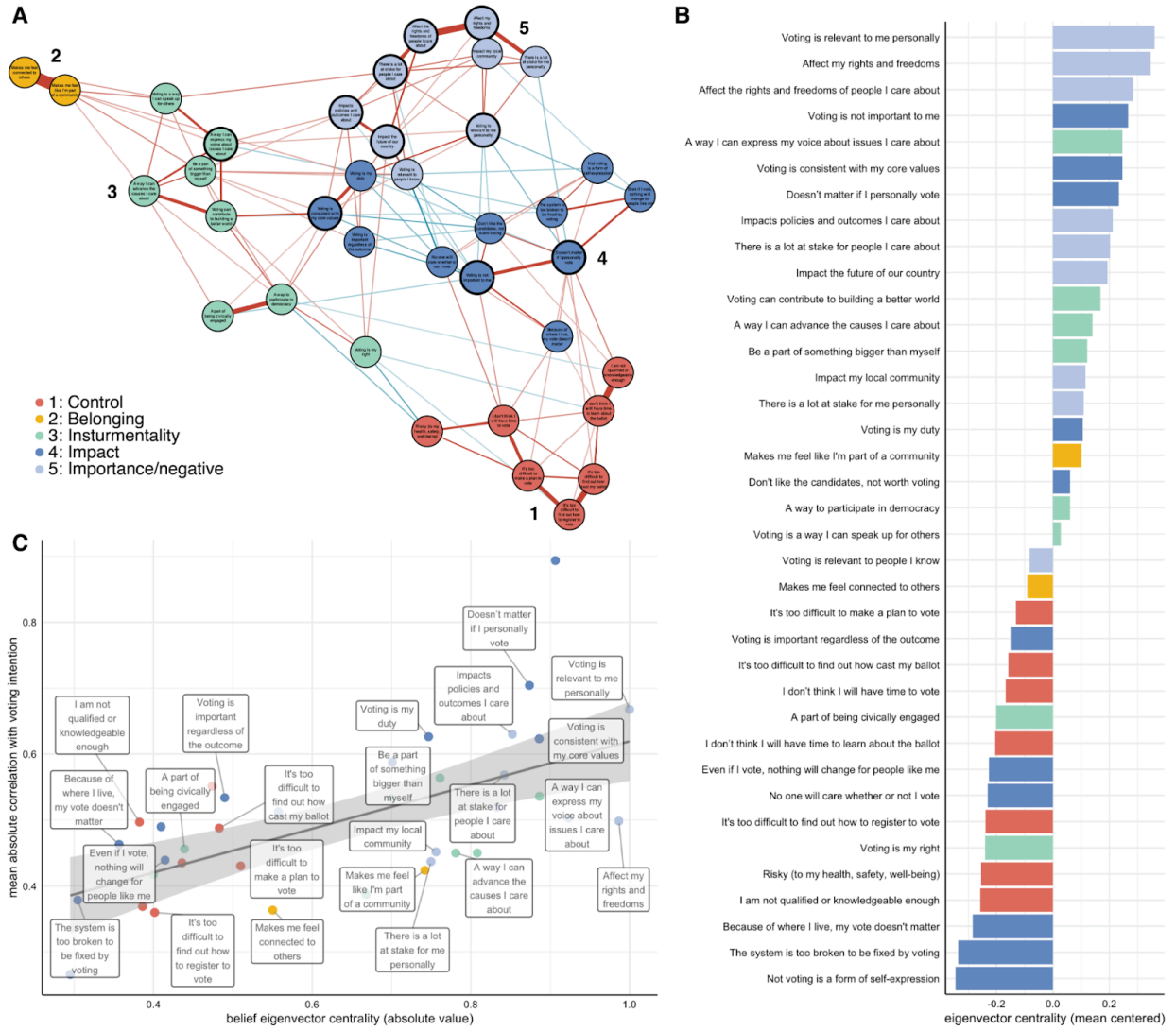

Figure 1. (A) Partial correlations among beliefs visualized as a network as a function of category. Nodes are colored based on their community, which is numbered. Edges for positive correlations are depicted in red and negative correlations are depicted in blue. The strength of the correlation is indicated by the width of the line. Nodes with the top ten highest centrality values are bolded. (B) Belief node centrality as a function of category. (C) Relationship

between belief node centrality and mean absolute correlation between belief strength and voting intention. Beliefs that were subsequently targeted in messaging are visualized in text bubbles. Belief text is abbreviated for visualization purposes.

Discussion

Study 1 surveyed college students to identify promising beliefs about voting to target via social media messaging. Voting beliefs ranged from being moderately to highly correlated with voting intentions and the majority of beliefs were not strongly held, indicating substantial potential to strengthen voting beliefs in this population. We used the Hornik & Woolf method to calculate the percentage to gain—that is, the possible increase in people who intend to vote (i.e., endorse "strongly agree") that could be achieved if everyone strongly held the belief. We identified 29 beliefs that had more than 20% to gain. These beliefs were from across belief categories, highlighting that there are numerous pathways to target voting beliefs through messaging.

Although the percentage to gain was the metric we used to inform message development in this project—that is, in the subsequent studies in this paper—we also conducted post-hoc analyses examining the structure of the voting belief network to inform future message development. We found that belief centrality and correlation with intentions were robustly related; beliefs with higher eigenvector centrality also tended to have higher average correlations with voting intentions. Given the strength of the correlation, considering belief centrality could provide a complementary method to determine which beliefs to target in messaging campaigns.

In this sample, behavioral beliefs about the personal importance of voting and the self-related and social consequences of the election tended to be most central, whereas control beliefs and negative behavioral beliefs related to disillusionment tended to be the least central. This suggests that messages that help people identify why voting is relevant to themselves and how the outcome of the election will impact themselves and their communities have greater potential to increase voting intentions because the underlying beliefs can activate other influential beliefs, strengthening the overall effect.

Although belief centrality was strongly associated with belief-voting intention correlations, it was not associated with percentage to gain. The percentage to gain metric combines information about strength of the relationship with intention (i.e., its correlation) but also how commonly held the belief is (i.e., the percentage to move). How central beliefs are was strongly related to the correlation with intention to vote but only weakly related to percentage to move, and this relationship was negative. This suggests that beliefs that are more central may also be somewhat more common. This underscores the usefulness of the Hornik & Woolf method, yet also suggests that formative research can gain unique insights from incorporating network approaches in tandem to identify influential beliefs that still have room to move.

Study 2: Message co-design and testing

The goal of this study was to develop nonpartisan, youth-focused GOTV messages targeting promising voting beliefs identified in Study 1 using the Hornik and Woolf method. In order to create messages that would be effective for college students, we used a participatory co-design process to develop the messages with undergraduate researchers on our team. Participatory approaches acknowledge lived experience as a form of expertise and seek to center it in research (Cornish et al., 2023; Ozer et al., 2024). Supporting the population of interest to shape the research can increase its potential to generate impactful and implementable solutions (Mansbridge, 2019). We adopted a similar approach to other youth-focused message co-design studies (Kikut-Stein et al., 2024; Kikut-Stein et al., 2025) and iteratively designed and refined nonpartisan GOTV messages using online message testing.

We conducted this study in two phases with two samples. In the Message development sample, we recruited a national sample of college students via the Prolific platform to quickly test a large set of initial messages. Based on this initial testing, we then refined the messages and tested a subset of the messages in a sample from our target population—college students at the University of Pennsylvania (Message testing sample). In both samples, participants viewed messages and rated perceived argument strength, nonpartisanship, and the correspondence between each message and targeted beliefs.

Methods

Participants

Message development sample

The first round of message development took place via an online survey administered via Qualtrics with participants recruited from Prolific (*N* = 126), an online labor marketplace. Inclusion criteria were as follows: current college students in the U.S., aged 18-22 years, fluent in English, and eligible to vote in the November 2024 general election. The mean age of respondents was 20.7 (SD = 1.3). The distribution of self-reported gender identity was as follows: 47.6% men, 45.2% women, 0% genderqueer, 4.8% non-binary, 0.8% preferred not to say, and 0.8% preferred to self-describe. With respect to race and ethnicity, participants identified as the following: 47.8% White, 8.0% East Asian, 22.5% Black or African American, 2.2% South Asian, 4.3% Southeast Asian, 2.2% Middle Eastern or North African, 3.6% American Indian or Alaskan Native, 2.2% Native Hawaiian or Other Pacific Islander, and 3.6% other racial/ethnic identity. 19.0% of participants also identified as Hispanic or Latina/o/x. This study was approved by the University of Pennsylvania Institutional Review Board and participants gave informed consent. Participants were compensated $2 for completing a 10-minute survey.

Message testing sample

The second round of message testing took place via an online survey administered via Qualtrics that recruited students at the University of Pennsylvania (*N* = 198). Inclusion criteria were as follows: current undergraduate students at the University of Pennsylvania, aged 18+, fluent in English, and eligible to vote in the November 2024 general election. One person was excluded for being >25 years old and 8 people were excluded due to technical errors that led them to be unable to view the images, yielding a final sample of N = 189. Participants in this sample were aged 18-22 (*M* = 19.7, *SD* = 1.2). Regarding gender, participants self-identified as the following: 27.5% men, 69.8% women, 1.1% genderqueer, 0% non-binary, and 1.6% preferred not to say. With respect to race and ethnicity, participants identified as the following: 47.5% White, 23.2% East Asian, 8.6% Black or African American, 10.1% South Asian, 3.5% Southeast Asian, 1.0% Middle Eastern or North African, and 2.0% other racial/ethnic identity. 15.9% of participants also identified as Hispanic or Latina/o/x. This study was approved by the University of Pennsylvania Institutional Review Board and participants gave informed consent. Participants were compensated via course credit for completing a 15-minute survey.

Procedure

Written message co-creation

We iteratively and collaboratively developed messages targeting promising beliefs identified in Study 1. Research team members each chose 2-4 promising beliefs and brainstormed two messages for each belief. Ideas were not limited to text-based messages but also included visual arguments (e.g., short comics or single-panel illustrations). In line with Hornik & Woolf method, we only targeted beliefs that we determined could plausibly be changed by messaging campaigns. Targeted beliefs are highlighted in Figure 1C. We then refined the messages through an iterative process of review and revision. Overall, we aimed to develop a set of nonpartisan messages that covered a broad range of beliefs and topics.

Visual message co-creation

We adapted the message text to create visuals for use on social media. A research team member with expertise in visual design developed images using Canva, an online design tool. The key features that were considered during adaptation included the target audience (young adults), demographic diversity (e.g., with respect to race, ethnicity, and gender), visual accessibility (e.g., colors with enough contrast to be seen clearly by most viewers), appropriate visual themes (images that symbolize voting, civic engagement, etc.). Images were then iteratively refined in response to feedback from the research team. The initial stimulus set used in the Message development sample contained 29 messages. After initial testing, three additional messages that combined informational and persuasive elements from other messages were developed for testing in the Message testing sample. All messages and alternative text can be found online: https://osf.io/axrc7.

Message testing surveys

Message development sample

At the beginning of the online survey, participants provided informed consent and were then shown 12 messages. Messages were separated into four thematic groups for presentation in the survey—self, social, duty and response efficacy, and informational—and participants saw a random sample of 3 messages from each group. For each message, participants rated perceived argument strength (Zhao et al., 2011), nonpartisanship, and message alignment with the beliefs it was designed to target. Perceived argument strength was assessed with nine items using a 5-point Likert-type agreement scale (1 = Strongly disagree, 5 = Strongly agree) or a 5-point Likert-type strength scale (1 = Very weak, 5 = Very strong) for statement strength. Nonpartisanship was measured using a single item ("This statement is nonpartisan"; 1 = Strongly disagree, 5 = Strongly agree). Belief alignment was measured by asking participants to rate their agreement that "This message makes me believe…" for a set of beliefs using a 7-point Likert-type scale (1 = Strongly disagree, 7 = Strongly agree). Beliefs were grouped such that only beliefs related to the message thematic group were presented for each message. Each category included 3-5 beliefs; examples include: "There is a lot at stake for me personally in the election" (*self* group); "Voting allows me to be a part of something bigger than myself" (*social* group); "The system is too broken to be fixed by voting" (*duty and response efficacy* group); "It's too difficult or effortful to make a plan to vote" (*informational* group). After rating the messages, participants reported demographics and completed individual difference measures not discussed in this paper.

Message testing sample

A similar procedure was used to test a set of 14 messages, which were selected and refined based on the results from the Message development sample. Twelve messages from the Message development sample were selected based on the message effectiveness criteria outlined in the following paragraph. Three new messages were created that blended information about how to vote from the informational messages with persuasive content from social messages that were not selected. However, due to a technical error, one of these new messages was not presented, resulting in a total of 14 messages. For randomization purposes, these messages were separated into two groups in the survey—one that combined self and duty messages, and one that combined social and response efficacy messages. Participants were presented with a random sample of five messages from each group for a total of 10 messages. For each message, they followed the same rating procedure as in Study 2a.

Determining message effectiveness

We evaluated the effectiveness of the messages by considering ratings of nonpartisanship, argument strength and belief strength. First, we excluded messages rated as somewhat partisan (i.e., the

average nonpartisan rating was below the midpoint of the scale disagreeing that the message was nonpartisan; *n* = 1 in the Message development sample). Then, we created a composite score integrating argument and target belief strength. Because we sought to identify messages that induced targeted beliefs and made strong, persuasive arguments about voting, we used a multiplicative approach (i.e., multiplying argument and belief strength) requiring both dimensions to be high to achieve a high score.

Associations between promising belief metrics and message effectiveness

Building on the results from Study 1 showing that percentage to gain and belief centrality might both be used to guide message development, we conducted post-hoc analyses examining relationships between these metrics for the beliefs targeted in each message and message effectiveness. We combined data from the Message development and testing samples and averaged centrality and percentage to gain across all beliefs targeted in each message to get a single value for each, per message. We then fit linear mixed effects models regressing message effectiveness on all potential models including the fixed effects of centrality and percentage to gain and used model comparison to select best fitting models. Results for the composite score are reported in the main manuscript and results for argument and belief strength are reported in Supplementary Material along with detailed methods.

Results

Message development sample

The goal of this analysis was to select a set of 15 messages that could be used in subsequent message testing in our target audience—college students at the University of Pennsylvania (Message testing sample). Messages were ranked by message effectiveness score to guide selection (Figure 2). Overall, self-related messages targeting behavioral beliefs about the impact, importance, and instrumentality of voting tended to be the most effective (Table 3). Notably, informational messages targeting control beliefs were the least effective. Because these messages did not include persuasive arguments, we generated three new messages that combined information about how to vote with persuasive elements from social messages targeting normative beliefs about belonging for testing in the Message testing sample. To create a set of 15 messages, we selected the 12 messages with the highest message effectiveness scores, which included self-related (*n* = 7), social (*n* = 2), response efficacy (*n* = 2), and duty (*n* = 1) messages. Mean nonpartisan ratings, argument strength ratings, belief strength ratings, and composite scores for individual messages are reported in Supplementary Material (Table S6).

Table 3

Message effectiveness by targeted belief cluster in the Message development sample

Targeted belief cluster	Nonpartisan rating *M* (*SD*)	Argument strength *M* (*SD*)	Belief strength *M* (*SD*)	Effectiveness score *M* (*SD*)
Belonging	3.97 (1.07)	3.49 (0.93)	5.14 (1.61)	18.95 (8.93)
Control	3.92 (1.09)	3.33 (0.93)	3.48 (1.83)	11.18 (6.46)
Impact	3.34 (1.27)	3.81 (0.85)	5.44 (1.46)	22.77 (8.12)
Importance/negative	3.72 (1.13)	3.54 (1.00)	3.59 (2.04)	19.25 (9.33)
Instrumentality	3.92 (1.10)	3.73 (0.86)	5.38 (1.47)	20.91 (8.48)

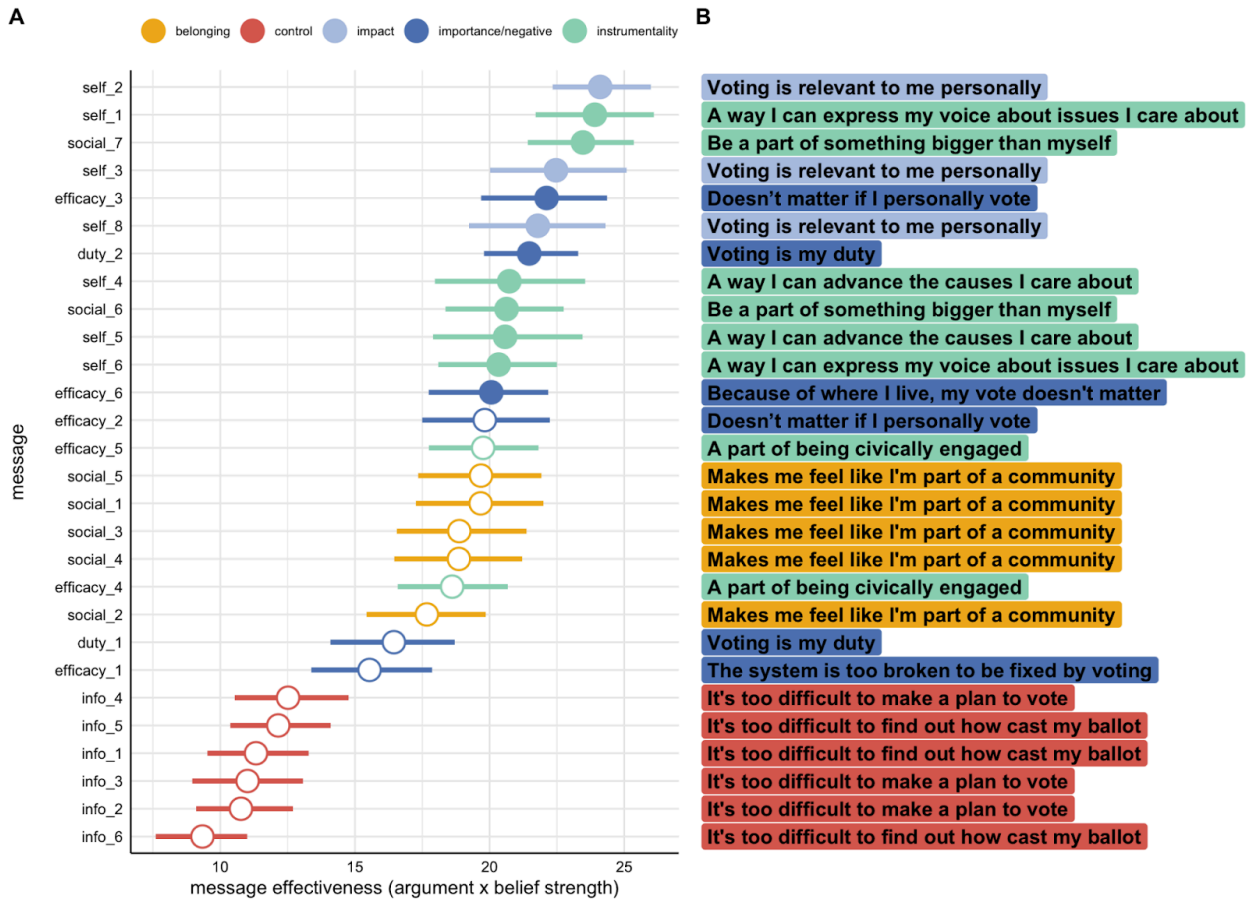

Figure 2. Message effectiveness scores and central voting beliefs targeted in the Message development sample. The top 12 messages that were selected for message testing are depicted with filled circles. Error bars represent 90% confidence intervals. Belief text is abbreviated for visualization purposes.

Message testing sample

Descriptives

All messages (Figure 3A) were rated as nonpartisan (M_{range} = 3.46 - 4.17). Descriptively, self-related messages targeting behavioral beliefs about the impact of the election (e.g., self_2: "The outcome of the election will impact these issues for better or worse… vote to have a say in what happens.") made the strongest arguments (*M* = 3.83, *SD* = 0.73*)*, followed by messages targeting: behavioral beliefs about the importance of voting (e.g., efficacy_6: "Myth: Voting doesn't matter if I'm not in a swing state. Fact: 33 states have Senate seats open and every state has Representative seats open — the ballot is more than a presidential election!") and negative beliefs (e.g., efficacy_3: "If your vote doesn't matter, no one's does. Every vote counts!"; *M* = 3.67, *SD* = 0.80), behavioral beliefs about the instrumentality of voting (e.g., self_1: "Do you care about ___? Voting is a way to express concerns on an issue together."; *M* = 3.43, *SD* = 0.81), and the combined messages targeting control and belonging beliefs (e.g., "Voting is confusing! It's easier to make sense of it together. Share this step-by-step guide with people you care about! usa.gov/how-to-vote"; *M* = 3.24, *SD* = 0.85). A similar order was observed for belief strength: impact beliefs (*M* = 5.42, *SD* = 1.37), instrumentality beliefs (*M* = 5.08, *SD* = 1.44), control + belonging beliefs (*M* = 4.06, *SD* = 1.65), and importance/negative beliefs (*M* = 3.29, *SD* = 1.95).

Selection

The goal of this analysis was to select the five best performing messages to use in a subsequent message experiment (Study 3). As in the Message development sample, messages were ranked and selected based on the message effectiveness scores (Figure 3B). However, two messages in the top five targeting self-related beliefs (self_1 and self_3) were very similar. We therefore selected the simpler of these two messages along with the sixth most effective message to test in Study 3.

Table 4

Message effectiveness and nonpartisanship for each message tested in the Message testing sample

Targeted belief cluster	Message	Nonpartisan rating *M* (*SD*)	Argument strength *M* (*SD*)	Belief strength *M* (*SD*)	Effectiveness score *M* (*SD*)
Belonging + control	social_info_1	3.92 (1.08)	3.28 (0.81)	3.16 (1.59)	16.15 (7.55)
	social_info_2	4.06 (1.00)	3.21 (0.87)	4.68 (1.38)	15.74 (7.29)
Impact	self_2	3.53 (1.13)	4.00 (0.67)	5.72 (1.17)	23.45 (7.51)
	self_3	3.49 (1.10)	3.76 (0.76)	5.43 (1.45)	21.04 (8.19)
	self_8	3.71 (1.07)	3.71 (0.72)	5.10 (1.41)	19.62 (8.04)
Importance/negative	duty_2	4.01 (1.06)	3.47 (0.78)	4.99 (1.59)	18.16 (8.05)
	efficacy_3	4.17 (0.95)	3.77 (0.82)	2.30 (1.45)	21.97 (8.52)
	efficacy_6	4.09 (1.00)	3.78 (0.76)	2.55 (1.52)	20.81 (7.78)
Instrumentality	self_1	3.46 (1.20)	3.76 (0.70)	5.53 (1.30)	21.42 (7.66)
	self_4	4.08 (0.96)	3.40 (0.82)	5.17 (1.44)	18.37 (8.01)
	self_5	3.89 (1.05)	3.39 (0.84)	5.00 (1.59)	17.90 (8.41)
	self_6	4.06 (0.95)	3.32 (0.84)	4.96 (1.50)	17.34 (7.97)
	social_6	4.03 (0.98)	3.30 (0.78)	4.56 (1.41)	15.81 (7.11)
	social_7	4.02 (1.06)	3.42 (0.77)	5.17 (1.23)	18.28 (7.05)

Associations between promising belief metrics and message effectiveness

Post-hoc analyses showed that percentage to gain and belief centrality were each uniquely positively associated with message effectiveness scores (Table S8; Figure S2). However, the relationship with belief centrality was approximately 2.5 times stronger (β = 0.44, 95% CI [0.28, 0.59], t(28.05) = 5.87, p < .001) than with percentage to gain (β = 0.17, 95% CI [0.01, 0.34], t(26.81) = 2.14, p = .042). All statistics from this model, the models including argument and belief strength as outcomes, and model comparison metrics are reported in Supplementary Material Tables S7-8.

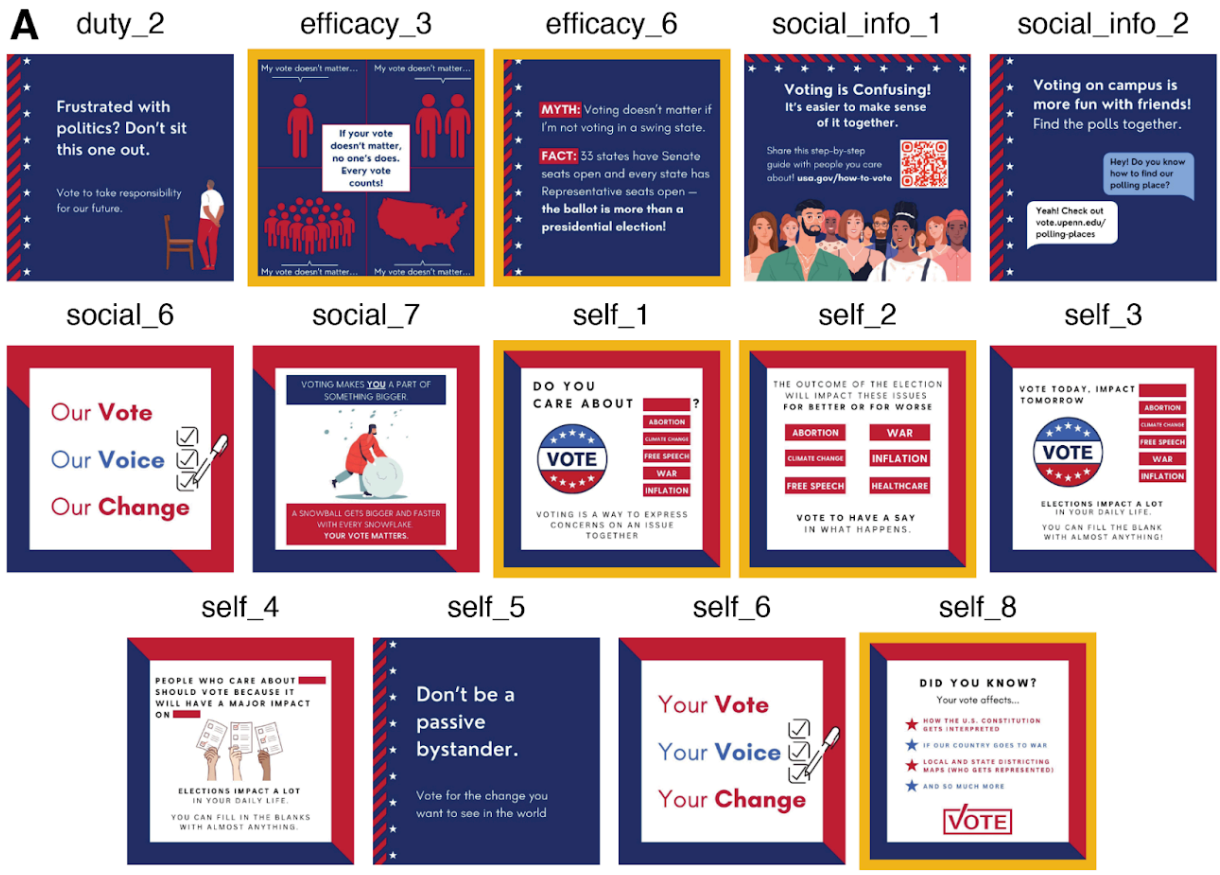

Figure 3. (A) Messages included in the Message testing sample. Messages selected for the Study 3 message experiment are outlined in yellow. (B) Message effectiveness scores and central voting beliefs targeted. Messages selected for the message experiment are depicted with filled circles. Error bars represent 95% confidence intervals. Belief text is abbreviated for visualization purposes. Alternative text for messages can be found in Table S5.

Discussion

In Study 2, we developed and validated nonpartisan GOTV messages targeting promising beliefs identified in Study 1. We assessed message effectiveness in terms of argument (i.e., persuasiveness and effectiveness at motivating voting) and belief strength (i.e., elicitation of the promising belief targeted). In the Message development sample—a national sample of college students—self-related messages targeting behavioral beliefs about the self-relevance (e.g., "Voting is relevant to me personally") and instrumentality of voting (e.g., "Voting is a way I can advance the causes I care about") tended to be most effective, whereas informational messages targeting control beliefs ("It's too difficult or effortful to make a plan to vote") were the least effective. The effectiveness of messages targeting beliefs about duty (e.g., "Voting is my duty"), response efficacy (e.g., "Because of where I live and vote, my vote doesn't matter"), and belonging (e.g., "Voting makes me feel like I'm part of a community") were more variable.

Testing the subset of most effective messages from the Message developmental sample (and new messages targeting informational and social belonging beliefs together) in a local sample of college students revealed similar results. Even when combined with social themes, informational messages targeting control beliefs tended to perform the worst, both with respect to argument and belief strength. This is noteworthy given that prior research has explained low youth voter turnout in terms of informational barriers about how to vote (e.g., Feldman et al., 2007; McDevitt & Chaffee, 2000; Syvertsen et al., 2009; Bergan et al., 2021; Bennion and Nickerson, 2016; McKinney & Banwart, 2005). This suggests that while information is necessary—particularly among youth who have not had the opportunity to develop voting habits—it may not be sufficient to shift control beliefs about voting in ways that affect downstream voting intentions. From this sample, we selected five of the best performing messages to test in a subsequent message experiment.

We also conducted post-hoc analyses combining across samples to explore whether and how strongly promising belief metrics identified in Study 1 were related to message effectiveness ratings. We found that messages targeting beliefs with higher percentages to gain and centrality were also rated as more effective. Percentage to gain and centrality each independently predicted message effectiveness, highlighting their utility as complementary measures. However, belief centrality was more strongly associated with message effectiveness than percentage to gain, and also predicted both argument and belief strength, whereas percentage to gain only predicted belief strength. Together, these findings establish links between promising belief metrics and subsequent message effectiveness perceptions and further demonstrate the potential for network approaches to guide campaign development.

Study 3: Message experiment

In Study 3, we conducted an experiment with two primary aims. First, we sought to test the effectiveness of the co-designed GOTV messages targeting promising beliefs compared to existing youth-focused GOTV messages on social media from both national and local campaigns. Second, we sought to assess how well the GOTV messages co-designed with and for undergraduates our university would generalize to a national sample of college students. We chose to prioritize ecological validity over tight experimental control and selected existing messages on social media from *Rock the Vote* as national message controls. We focused on *Rock the Vote* because it is one of the oldest and best established nonpartisan national organizations focused on youth voter engagement and has substantial reach (Rock the Vote, 2025). Although our co-designed messages were persuasive, we also included informational messages since providing youth with voting information is a common strategy in youth-focused campaigns (e.g., Bennion & Michelson, 2023, Feldman et al., 2007; McKinney & Banwart, 2005) and generic messages (e.g., an image of an "I voted" sticker) as a low-level control.

In our primary analyses, we predicted that across message types participants would rate the co-designed messages targeting promising voting beliefs (*co-designed messages*) as more motivating,

persuasive, and self-relevant than messages from *Rock the Vote* (*control messages*). Considering each type of message separately, we expected that the co-designed messages would be more motivating, persuasive, and self-relevant than informational and generic control messages and at least or more motivating, persuasive, and self-relevant than persuasive control messages. To evaluate the impact of developing messages for our local audience using formative research, we also conducted supplementary analyses using existing messages generated by students from our GOTV partner organization as controls. The hypotheses and the analysis plan were preregistered before data collection (https://osf.io/4jdxh).

Methods

Power

Our target sample size was determined by an *a priori* power analysis and found that a sample of 250 participants would be sufficient to detect a within-person condition difference (i.e., co-designed versus control messages) for an effect size of Cohen's $d = 0.1$ with >80% power and $d = 0.15$ with >99% power. We collected two samples—one local sample of students at our university and one national sample of college students—and aimed to recruit 250 participants in each. However, given the short timeline between the study launch and election day, we were only able to recruit 73 participants in the local sample. For this sample, we were powered to detect an effect of $d = 0.17$ with >80% power.

Participants

In the Local sample, participants ($N = 72$) were recruited from the student participant pool at the University of Pennsylvania and were eligible to participate if they were 18 or older, eligible to vote in the 2024 U.S. general election, and had not participated in Study 2. In the National sample, participants ($N = 251$) were recruited from Prolific and were eligible to participate if they were college students in the U.S. between the ages of 18-22 and eligible to vote in the 2024 U.S. general election. Two participants in the national sample were excluded from analysis for reporting they were older than 25 (final $N = 249$).

Participants' ages were similar across the two samples (Local sample: $M = 20.2$, $SD = 1.3$; National sample: $M = 20.4$, $SD = 1.4$). In the Local sample, participants reported the following gender identities: 59.7% women, 38.9% men, 0% genderqueer, 0% non-binary, 1.4% preferred not to say, 0% preferred to self describe. The gender distribution was similar in the National sample: 57.0% women, 36.5% men, 0% genderqueer, 4.4% non-binary, 0.4% preferred not to say, 0.4% preferred to self describe.

In the Local sample, participants reported the following racial identities: 47.4% White, 22.4% East Asian, 11.8% Black or African American, 7.9% South Asian, 5.3% Southeast Asian, 2.6% Middle Eastern or North African, 0% American Indian or Alaskan Native, 0% other racial/ethnic identity not listed, 0% Native Hawaiian or Other Pacific Islander). In addition, 8.3% of participants identified as Hispanic or Latina/o/x. The National sample included fewer Asian participants and more Black participants than the Local sample: 49.5% White, 10.1% East Asian, 21.3% Black or African American, 3.5% South Asian, 6.6% Southeast Asian, 1.0% Middle Eastern or North African, 2.4% American Indian or Alaskan Native, 3.1% other racial/ethnic identity, 0.7% Native Hawaiian or Other Pacific Islander. In addition, more participants (19.3%) identified as Hispanic or Latina/o/x.

This study was approved by the University of Pennsylvania Institutional Review Board and participants gave informed consent. Participants in the Local sample were compensated via course credit for completing a 15-minute survey and participants in the National sample were compensated $2 for completing a 10-minute survey.

Procedure

For this experiment we used a within-subjects design in which each participant rated a subset of messages from all conditions. The experiment included two primary message types across both samples:

messages targeting promising beliefs, co-designed with youth (co-designed messages) and a set of messages from a national nonpartisan GOTV organization, *Rock the Vote* (control messages). The control messages enabled us to compare our experimental messages with ecologically-valid, existing messages that also targeted youth but were presumably designed without insights from youth partners and formative research. In the Local sample, we also tested the co-designed messages against messages previously created and disseminated by our partner organization, *Penn Leads the Vote* (PLTV), that were designed by youth but did not target promising beliefs identified in formative research ("student control messages"). Results from these secondary analyses are reported in the Supplemental Material.

The co-designed messages consisted of 5 messages selected from Study 2 targeting beliefs about the self-relevance of voting (self-related beliefs) and the belief that an individual's vote matters (response efficacy beliefs). These messages aimed to influence participants' attitudes toward voting by highlighting personal significance and the impact of one's vote. Control messages were categorized as either *generic* messages (e.g., "Vote Vote Vote!" or images of "I voted" stickers), *informational* messages (messages that provide helpful instructions, such as how to complete mail-in ballots), or *persuasive* messages (messages that aim to motivate action by making an argument, e.g., "If you don't register, you can't vote. Which means you don't get a say in our democracy."). The control messages across both samples were derived from *Rock the Vote*'s Instagram posts shared between June and October of 2024. We selected 15 control messages that met the following criteria: (a) nonpartisan content, (b) classification as either generic, informational, or persuasive, (c) not targeting specific groups (e.g., Black voters or women voters), (d) not referencing expired deadlines (e.g., past voter registration deadlines), and (e) standalone graphics without captions or additional information. The 15 control messages included 5 generic messages, 5 informational messages, and 5 persuasive messages. All messages and alternative text can be found online: https://osf.io/axrc7.

In both samples, participants viewed the same set of 5 co-designed messages, as well as a random subset of 5 control messages sampled from the set of 15. All messages were presented in a randomized order. Participants used a sliding scale (0 = strongly disagree, 100 = strongly agree) to rate each message on three primary outcome measures: motivation to vote ("This message motivates me to vote"), persuasiveness ("This message is persuasive"), and self-relevance ("This message is relevant to me"). They also rated the messages on additional measures, described in Supplementary Material.

Statistical analyses

Our primary analyses tested the effect of *message source* (co-designed or control) on message motivation to vote, persuasiveness, and self-relevance collapsed across *message types* (persuasive, informational, or generic). For each outcome, we fit a separate linear mixed effects model regressing the dependent variable on the fixed effect of message source and intercepts were allowed to vary randomly across participants. To test whether the effect of message source varied by message type, we fit the same models within each message type separately. We checked each model for modeling assumption violations, including normality of residuals and heteroskedasticity. No assumptions were violated and no data transformations were performed. As preregistered, we did not exclude or transform any outliers. We conducted exploratory analyses to examine generalizability of messages from local to national samples by including sample and its interaction with message source as fixed effects. The following additional analyses are reported in Supplementary Material: preregistered secondary analyses examining student-generated control messages and sharing and emotions ratings across samples; sensitivity analyses controlling for aesthetic quality and nonpartisanship; and exploratory message-level analyses.

Results

Descriptive statistics

Means and standard deviations for our primary outcomes are reported for each sample separately in Table 5. Descriptive statistics for all outcomes are reported in Table S9-10.

Table 5

Means and standard deviations of message ratings as a function of sample

	Co-designed messages *M* (*SD*)		Control messages *M* (*SD*)	
Dependent variable	Local	National	Local	National
Motivation	57.39 (27.72)	60.99 (30.32)	41.52 (29.76)	46.74 (31.63)
Persuasiveness	57.79 (27.85)	60.93 (28.61)	42.35 (28.77)	43.92 (30.59)
Self-relevance	59.72 (27.59)	60.92 (30.50)	52.87 (30.49)	54.36 (32.11)

Primary analyses

Across message types, we predicted that the co-designed messages targeting promising voting beliefs would be more motivating, persuasive, and self-relevant than control messages from *Rock the Vote*. We found strong evidence for all three hypotheses (Table 3). Compared to control messages, the co-designed messages were substantially more motivating (b = 14.58, 95% CI [12.97, 16.19]) and persuasive (b = 16.68, 95% CI [15.03, 18.32]), and moderately more self-relevant (b = 6.70, 95% CI [5.18, 8.24]). Examining potential differences between message types, we found as expected that the co-designed messages were more motivating and persuasive than generic, informational, and persuasive control messages. However, the co-designed messages were only more self-relevant than generic and persuasive control messages but not informational control messages. Statistics for all models are reported in Table 3. Sensitivity analyses controlling for nonpartisanship and aesthetic quality of the messages slightly weakened the magnitude of the experimental effects, but all remained statistically significant (Table S12). Message-level effects are reported in Supplementary Material (Figure S3).

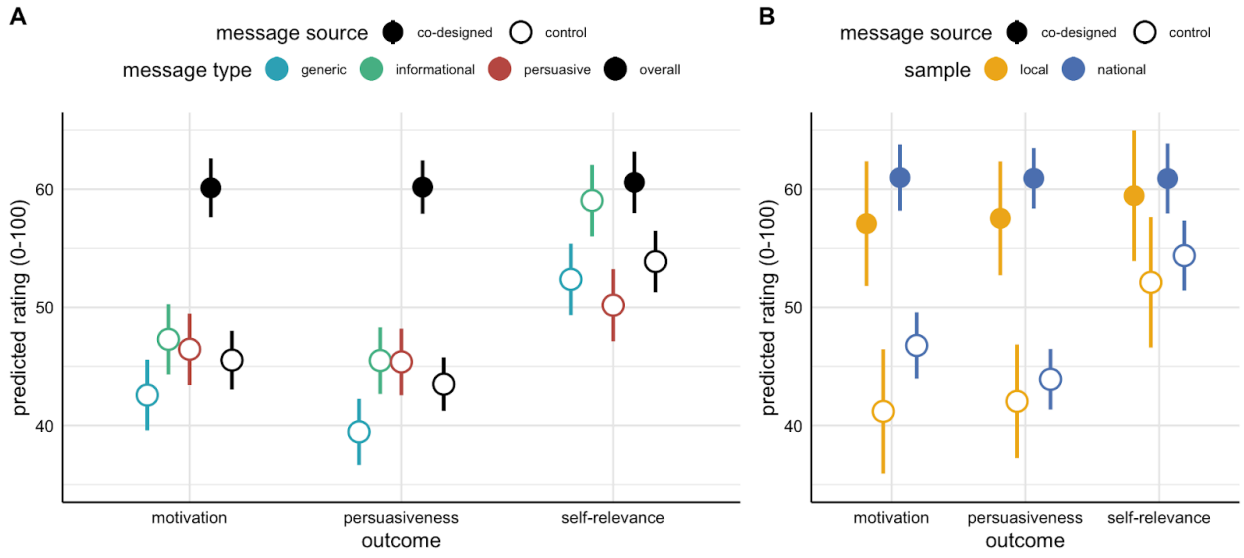

Figure 4. Mean estimates from linear mixed effects models for message motivation to vote, persuasiveness, and self-relevance. (A) Message effects as a function of message source (co-designed or control) and message type. Black points and error bars show effects from models collapsed across message types. Colored points and error bars are from models comparing the co-designed messages to each control message type (generic, informational,

persuasive). (B) Message effects across message types as a function of sample (local or national). Error bars are 95% confidence intervals.

Table 6
Model summary for primary hypothesis tests

DV	Message type	Marginal R^2 / Conditional R^2	N (*df*)	Variable	*b*	95% CI	*t*	*p*
Motivation to vote	Overall	0.05 / 0.46	321 (399.45)	Intercept	45.53	43.04 - 48.02	35.97	< .001
			321 (2823.24)	Source (co-designed)	14.58	12.97 - 16.19	17.73	< .001
	Generic	0.06 / 0.50	320 (657.86)	Intercept	42.58	39.58 - 45.58	27.89	< .001
			320 (1807.07)	Source (co-designed)	17.60	15.36 - 19.84	15.44	< .001
	Informational	0.03 / 0.51	319 (632.14)	Intercept	47.30	44.32 - 50.27	31.21	< .001
			319 (1799.96)	Source (co-designed)	12.83	10.67 - 14.99	11.67	< .001
	Persuasive	0.04 / 0.50	321 (652.58)	Intercept	46.45	43.43 - 49.47	30.18	< .001
			321 (1807.56)	Source (co-designed)	13.65	11.41 - 15.88	11.98	< .001
Persuasiveness	Overall	0.07 / 0.41	320 (421.09)	Intercept	43.50	41.24 - 45.77	37.76	< .001
			320 (2830.38)	Source (co-designed)	16.68	15.03 - 18.32	19.92	< .001
	Generic	0.09 / 0.44	320 (768.67)	Intercept	39.46	36.65 - 42.27	27.59	< .001
			320 (1819.77)	Source (co-designed)	20.75	18.46 - 23.04	17.75	< .001
	Informational	0.05 / 0.44	319 (728.41)	Intercept	45.49	42.67 - 48.31	31.66	< .001
			319 (1812.61)	Source (co-designed)	14.69	12.46 - 16.92	12.92	< .001
	Persuasive	0.05 / 0.42	320 (763.07)	Intercept	45.38	42.56 - 48.20	31.60	< .001
			320 (1818.54)	Source (co-designed)	14.82	12.52 - 17.11	12.67	< .001
Self-relevance	Overall	0.01 / 0.49	321 (383.59)	Intercept	53.88	51.27 - 56.49	40.57	< .001
			321 (2835.80)	Source (co-designed)	6.70	5.16 - 8.24	8.51	< .001
	Generic	0.01 / 0.52	321 (604.47)	Intercept	52.37	49.34 - 55.40	33.95	< .001
			321 (1811.41)	Source (co-designed)	8.24	6.11 - 10.37	7.58	< .001
	Informational	0.00 / 0.52	320 (599.70)	Intercept	59.04	56.01 - 62.06	38.28	< .001
			320 (1807.40)	Source (co-designed)	1.57	-0.54 - 3.69	1.46	.144
	Persuasive	0.02 / 0.54	321 (597.86)	Intercept	50.18	47.12 - 53.24	32.21	< .001
			321 (1809.21)	Source (co-designed)	10.41	8.28 - 12.54	9.57	< .001

Note. The reference level for Source is the control messages.

Generalizability analyses

We examined how well the messages generalized to a National student sample compared to the Local student sample at our institution where formative research was conducted. Across message types, we found that there were no statistically significant differences between the Local and National student samples (Table 7; Figure 4B). The National sample rated the control messages as slightly more motivating (b = 5.58, p = .067), but the difference between co-designed and control messages were similar in magnitude (bs = -0.82 – -1.68, ps > .05). That is, there were no statistically significant interactions between message source and sample, indicating that the co-designed messages were similarly effective for college students locally and nationally.

Table 7
Model summary for primary hypothesis tests collapsed across message types as a function of sample

DV	Marginal R^2 / Conditional R^2	N (*df*)	Variable	*b*	95% CI	*t*	*p*
Motivation to vote	0.06 / 0.46	321 (404.87)	Intercept	41.19	35.92 - 46.46	15.36	< .001
		321 (2828.36)	Source (co-designed)	15.89	12.43 - 19.35	9.01	< .001
		321 (403.14)	Sample (national)	5.58	-0.40 - 11.55	1.83	.067
		321 (2826.71)	Source (co-designed) x Sample (national)	-1.68	-5.59 - 2.23	0.84	.400
Persuasiveness	0.08 / 0.41	320 (423.00)	Intercept	42.05	37.23 - 46.87	17.15	< .001

		320 (2833.93)	Source (co-designed)	15.49	11.98 - 18.99	8.66	< .001
		320 (422.12)	Sample (national)	1.86	-3.59 - 7.32	0.67	.502
		320 (2832.68)	Source (co-designed) x Sample (national)	1.52	-2.45 - 5.49	0.75	.452
Self-relevance	0.01 / 0.50	321 (386.06)	Intercept	52.11	46.58 - 57.65	18.51	< .001
		321 (2838.57)	Source (co-designed)	7.33	4.04 - 10.63	4.37	< .001
		321 (384.99)	Sample (national)	2.27	-4.01 - 8.55	0.71	.477
		321 (2837.52)	Source (co-designed) x Sample (national)	-0.82	-4.54 - 2.91	0.43	.668

Note. The reference level for Source is the control messages and the local sample for Sample.

Student control message analyses

In the Local sample, we also compared our co-designed messages targeting promising voting beliefs against prior messages created independently by the student-led GOTV organization on campus who we partnered with as a set of secondary control messages. In line with preregistered hypotheses, compared to student messages created without a theoretical framework across message types, the co-designed messages were more motivating (b = 8.03, 95% CI [4.87, 11.18], t(613.36) = 5.00, p < .001) and persuasive (b = 11.00, 95% CI [7.51, 14.49], t(618.07) = 6.19, p < .001), and similarly were self-relevant (b = -2.83, 95% CI [-5.99, 0.33], t(622.49) = 1.76, p = .080). Model statistics and the results for each message type separately are included in more detail in Supplemental Materials (Table S13).

Discussion

In Study 3, we used a within-subject experimental design to determine the degree to which co-designing GOTV messages targeting promising voting beliefs in partnership with the target population increased message-related motivation, persuasion and self-relevance. We found evidence of substantial benefits to conducting formative research and tailoring messages to promising beliefs relevant to the target population. We also found that our co-designed messages were more motivating and persuasive than prior messages that were designed by members of the target population (via our student-led, campus partner) but without drawing on evidence-based insights from formative research. Therefore, these results highlight the importance of integrating theory-driven formative research *with* participatory co-design practices with members of the target population, to develop effective GOTV messages.

General discussion

Despite expressing high levels of political concern, young adults remain underrepresented at the polls. This work sought to develop effective communication strategies to address this longstanding gap in young Americans' civic life. Across three studies, we integrated formative research methods with a participatory co-design approach to develop and test get-out-the-vote (GOTV) messages targeting youth-specific voting beliefs. In the first study, we mapped beliefs associated with voting and identified promising beliefs that were strongly correlated with voting intentions and had the greatest opportunities for belief change through communication campaigns using standard methods. In exploratory network analyses, we also considered the relationships among these beliefs and demonstrated that network methods can be used as a complementary approach to identify influential beliefs in formative research. In the second study, we iteratively co-designed and tested messages to develop a set of messages that effectively targeted promising beliefs. Finally, the third study demonstrated that in both local and national samples, our top co-designed messages targeting key promising beliefs about the personal relevance and impact of voting were consistently rated as more motivating, persuasive, and personally relevant than messages designed by a prominent national youth-focused GOTV organization, *Rock the Vote,* and as more motivating and persuasive than prior messages made by our local student-led GOTV

organization partner. Together, these findings illustrate the promise of integrating theory-driven, formative research and human-centered, participatory approaches to develop messaging campaigns.

Formative research to identify promising voting beliefs

Building on standard message campaign development frameworks (Fishbein & Capella, 2006), this project used two novel approaches to conduct formative research—participatory elicitation methods to generate beliefs and network analyses to identify influential beliefs. Our research was grounded in the Reasoned Action Approach and Theory of Planned Behavior (TPB; Fishbein & Ajzen, 2010; Ajzen, 1991). Prior work has applied TPB to youth voting, but used single-item summary measures assessing attitudes, social norms, and perceived behavioral control and did not consider upstream beliefs shaping these perceptions (Glasford, 2008). Other work has considered beliefs about voting but has not systematically compared them in the context of TPB. We addressed these gaps by generating a large battery of beliefs through a participatory research process with student partners. Although many of these beliefs could be classified as control, normative, or behavioral beliefs, others were more nuanced and cut across categories (e.g., beliefs about social impacts of the election)—which was reflected in the network analysis, showing a mix of normative and behavioral beliefs in several clusters. While TPB does not define belief categories as mutually exclusive, these results highlight the importance of considering relationships among beliefs and suggest that data-driven network approaches can inform message design according to principles such as network control or activation spillover (Brandt & Sleegers, 2021).

The nuanced set of beliefs elicited in formative research was made possible by our student partner's input and led to the identification of numerous promising voting beliefs that could be targeted in GOTV messaging. Indeed, many of these beliefs had substantial percentages to gain compared to benchmarks from other studies (Hornik et al., 2019; Yang et al., 2023; Brennan et al., 2013). These beliefs were also aligned with prior work, highlighting voting beliefs relating to election consequences (Bali et al., 2020), self-relevance (Knoester & Kretz, 2017), efficacy (Harder & Krosnick, 2008; Condon & Holleque, 2013), knowledge and information (Maiello et al., 2003; Harder & Krosnick, 2008; Knoester & Kretz, 2017; Knoester & Gichiru, 2021; Kawashima-Ginsburg and Kiesa, 2019; Bergan et al., 2021; CIRCLE, 2022), sense of duty (Bali et al., 2020; Lydic et al., 2025; Harder & Krosnick, 2008; Blais & Daoust, 2020), and normative beliefs (Harder & Krosnick, 2008; Bali et al., 2020; Glynn et al., 2009; Bergan et al., 2021).

Although we relied on the Hornik and Woolf method to identify promising beliefs prior to message development, we also demonstrate the utility of using network methods to identify influential beliefs. Considering the relationships among beliefs was motivated in part by the observation that messages targeting less promising beliefs can still be effective if they are correlated with more promising beliefs (Lee et al., 2016). We found that belief centrality was positively associated with correlations with voting intentions, suggesting its viability as a metric to identify promising beliefs. Critically, belief centrality and percentage to gain were not correlated and some beliefs had notable discrepancies between these metrics. In particular, control beliefs and negative beliefs related to disillusionment had high percentages to gain, but low centrality. These messages also tended to be the least effective in Study 2, underscoring that belief centrality may add value beyond standard methods. In line with this, we also found that the most effective messages targeted beliefs with high network centrality. Direct comparisons of percentage to gain and belief centrality further reinforced this idea by showing that belief centrality was a stronger predictor of message effectiveness than belief centrality. Based on these results, future research can be designed to more explicitly test the following predictions: compared to messages targeting less central beliefs, messages targeting more central beliefs should be more effective and more strongly influence other beliefs leading to greater network-level belief change. Future research can also compare the utility of percentage to gain and network centrality to guide message development by comparing messages targeting beliefs with high percentage to gain but low centrality and vice versa.

Message effects

Many of the promising beliefs we identified were amenable to being targeted in nonpartisan messaging. Mirroring the results from our formative research, the most effective messages aimed to help people identify why voting is relevant to them, why their vote matters, and how the outcome of the election might affect them and people they care about. For example, the two most effective messages included "myth-busting" the insignificance of one's vote and encouraging the audience to connect voting to one's values without specifying particular policy positions. In contrast, social and informational messages about registering and voting were less effective, even when combined. We observed further evidence in the message experiment that informational messages are perceived as self-relevant but not motivating. This is an important insight because information and knowledge barriers are consistently highlighted in youth voting research (Maiello et al., 2003; Harder & Krosnick, 2008; Knoester & Kretz, 2017; Knoester & Gichiru, 2021; Kawashima-Ginsburg and Kiesa, 2019; Bergan et al., 2021; CIRCLE, 2022), are frequently discussed in social media messaging (Ad Council, 2020), and may feel like safer targets for nonpartisan GOTV organizations and nonprofits that must avoid perceptions of partisanship (Alliance for Justice, 2024; Nonprofit VOTE, 2024). Our findings demonstrate that GOTV messages can be motivating when targeting beliefs about the personal relevance of voting without evoking partisan cues and without focusing on single issues. By naming multiple issues and without specifying positions about them, these messages struck a balance between persuasiveness and nonpartisanship.

Co-designing these messages in partnership with students from the student-led, nonpartisan GOTV organization on campus (PLTV) in ways that combined their expertise with theory-driven frameworks increased message effectiveness. By integrating insights from behavior change and communication theory with lived experience and local knowledge from student partners, we developed messages that successfully targeted promising beliefs. This co-design process created messages that were perceived as more motivating, persuasive, and self-relevant than existing social media messages from *Rock the Vote,* a national nonpartisan GOTV organization aimed at (but not directed by) youth. We also found that our co-designed messages were more effective than messages previously created by our partner organization, PLTV (i.e., messages that were designed by youth but were not theory-driven and did not aim to target promising beliefs). Although we do not know how the *Rock the Vote* messages were developed (i.e., whether they were evidence-based or had input from youth) and therefore cannot make inferences about specific mechanisms, our findings demonstrate that the integration of theory-driven formative research and participatory co-design practices in partnership with the target audience is a fruitful framework for campaign development (Kikut-Stein et al. 2024a; 2024b). More broadly, this framework dovetails with recent calls to leverage youth expertise in the design and implementation of research-based GOTV interventions for more effective tailoring and to support youth civic engagement (Cosme et al., Under review.; Michelson & Ostfeld, 2024).

Critically, the co-design process created messages that were effective in our local context but also generalized beyond it. We found that the co-designed messages were equally effective in a national sample of college students, indicating that the promising beliefs we identified and the messages we developed targeting them were broadly relevant to college students. This finding is consistent with recent work applying YPAR approaches in health communication showing formative research and message development conducted locally can generalize nationally (Kikut-Stein et al, 2024b). This evidence underscores the feasibility of using this approach to develop GOTV messaging campaigns that can be implemented locally while simultaneously generating generalizable scientific knowledge.

Theoretical implications

These findings advance theory in political communication in several ways. First, it establishes the use of belief centrality as a complementary method for identifying promising beliefs to target in communication interventions and messaging campaigns. It extends gold-standard approaches like the

Hornik and Woolf method to take into account relationships among beliefs—a previously identified limitation (Lee et al., 2016)—and provides a similarly actionable ranking metric to guide belief selection and message design. Second, the data-driven network analyses add nuance to Reasoned Action Approaches like the Theory of Planned Behavior highlighting the interconnections among normative and behavioral beliefs. At least in the context of voting beliefs, normative and behavioral beliefs tended to cluster together rather than being segregated into separate clusters as might be predicted by theory. Similarly, self-related and social beliefs also tended to cluster together, mirroring previous findings that self-related and social motives are tightly linked in the context of message perception and sharing (Cosme et al., 2023; Cosme et al., 2025; Falk & Scholz, 2017). Third, these findings add further evidence that communication interventions that increase the salience of self-related and social motives can encourage prosocial behavior, such as voting, and information sharing (Albarracín et al., 2024; Cosme et al., 2025; Costa et al., 2018; French Bourgeois & de la Sablonnière, 2023; Sinclair et al., 2025). Importantly, our results suggest that at least in the context of youth voting, it may be more effective to target self-related beliefs, which can in turn activate social beliefs, as opposed to targeting social beliefs since the messages targeting social beliefs tended to be less effective. Finally, our results underscore how social norms and values like a sense of civic duty can be internalized so that they become core personal values (Bali et al., 2020; Lydic et al., 2025). Appeals to civic duty (Gerber & Green, 2017) and normative social pressure (Gerber et al., 2008; Panagopoulos, 2010; Rogers et al., 2017) are common in GOTV campaigns, but have the potential to backfire if they are perceived as controlling. Our findings suggest that communication interventions that help individuals identify why voting is aligned with their core values is another pathway to activate a sense of civic duty.

Practical implications

Beyond theoretical advancements, this project also has clear implications for practitioners seeking to develop youth-focused GOTV messaging. This research demonstrates that it is possible to develop persuasive and motivating GOTV messages that are nonpartisan by targeting promising beliefs in open-ended ways that allow the audience to reflect on the issues most relevant to themselves and their communities. It also indicates that communication interventions should go beyond simply providing informational content to overcome psychological barriers to voting. These results suggest that targeting behavioral beliefs about the personal relevance and importance of voting, the significance of an individual vote, and the impact the election will have on personally-relevant issues and outcomes may be impactful. Overall, we found that beliefs about the self-relevance and importance of voting and the personal consequences of the election tended to be the most promising and influential. Therefore, GOTV messaging campaigns and communication interventions that help individuals connect the act of voting to their core values and concerns may have greater potential to strengthen voting intentions.

This project also highlights the synergistic potential of adopting an iterative, participatory research approach to conduct formative research and co-design messages in partnership with youth. From a practical standpoint, scaling nonpartisan GOTV efforts requires strategically targeting beliefs about voting, particularly pertaining to the self-relevance of voting and voter efficacy, while ensuring clarity, minimal partisan cues, strong visuals, and authenticity through community-based design. We demonstrate that this approach can yield better political communication interventions while simultaneously serving as an opportunity to strengthen youth research skills and support civic education, development, and empowerment (Ozer et al., 2024). As was the case in our team, this framework can also create opportunities for noncitizen students to promote nonpartisan civic engagement. In sum, engaging in participatory action research in partnership with youth can lead to more effective political communication interventions and also create a positive culture of civic efficacy and collaboration between youth and adult researchers.

Limitations and future directions

These promising findings should be interpreted in light of several limitations. First, we cannot disentangle the two key features of our design process—formative research and message development—to determine the impact of each process in isolation. Rather, we show that co-design *in the process of* formative research and message development led to substantially better message effectiveness. Second, we focused on message-related perceptions and voting intentions rather than voting-related behavior (e.g., registration and voting). Although we did not directly measure voting behavior, the robust effects observed here suggest that theory-informed, co-designed communication interventions hold promise in closing the gap between concern about politics, intentions to vote, and actual voting behavior. In line with this, a recent field experiment showed that messages communicating the personal impact of voting increased voter turnout in a local election (Huber et al., 2022). Future research could investigate whether these immediate message-related effects translate into meaningful, lasting changes in voter registration or turnout. Third, we used controlled experimental methods to investigate message effectiveness and therefore cannot draw inferences about how effective these messages would be in situ. Research using field study methods to evaluate message effectiveness on real social media platforms is an important future direction, especially since prior research on GOTV campaigns targeting youth on social media have yielded mixed results (Unan et al., 2024; Teresi & Michelson, 2015). Fourth, we applied the belief network approach post-hoc and therefore future studies should examine its ability to guide identification of promising beliefs and message development from the outset. Fifth, although our samples were adequately powered for all analyses presented here, they precluded deeper exploration of demographic and individual differences in voting beliefs and message effects; future studies designed for this purpose would provide important contextual information to inform youth-focused GOTV campaigns. Finally, we collaborated with college students to design GOTV messages to motivate their peers to vote but did not test the degree to which voting beliefs and messages generalize to youth not enrolled in college. This is an important future direction as this group is contacted frequently by GOTV campaigns (CIRCLE, 2022) and therefore may especially benefit from receiving and shaping the development of GOTV communication interventions.

Conclusion

In a political climate where young adults are often characterized as disengaged, this study demonstrates the potential for theory-based, co-created messaging to bolster motivation to vote in this group. By integrating formative research with participatory co-design, we developed messages that outperformed national youth-focused communication campaigns in their immediate psychological impact. These promising findings testify to the reciprocal benefits of combining theoretical rigor with the lived insights of the communities that campaigns aim to engage. In doing so, they offer a blueprint for communication scholars, practitioners, and civic organizations seeking to catalyze meaningful engagement among emerging generations of voters. Crucially, research partnerships between these groups creates a framework that enables rapid translation of research into direct implementation, which in turn can inform the next cycle of research through insights gained from implementation. As civic and educational organizations look to scale their efforts, embedding co-design throughout the research and delivery pipeline offers a clear path toward messages that are at once persuasive, portable, and powerfully rooted in community experience.

Data availability statement: The code and data to replicate the results reported in this paper are available on Github at: https://github.com/cnlab/PLTV-GOTV-2024.git. To protect the privacy of participants, demographic data are not shared and analyses including these data cannot be replicated.

Disclosure statement: The authors report there are no competing interests to declare.

Funding statement: This research was supported by a course development grant from the Netter Center for Community Partnerships at the University of Pennsylvania.

Notes on contributors:

Kirsten Lydic is a Ph.D. candidate at the University of Pennsylvania Annenberg School for Communication and member of the Communication Neuroscience Lab. She is also a steering committee member of the Center for Media at Risk, Annenberg School for Communication, University of Pennsylvania.

Omaya Torres-Grillo is a Senior Research Coordinator of the Communication Neuroscience Lab and a joint research fellow with the Communication Neuroscience Lab at the University of Pennsylvania.

Julia Levine, Sophia Lee, Paula Vekker, Pètra de Beer, and Lyan Casamalhuapa are undergraduate students or recent graduates at the University of Pennsylvania. During this project, they were associated with the undergraduate-led campus voting organization, *Penn Leads the Vote*.

Emily Falk is a Professor in the Annenberg School for Communication with appointments in the Department of Psychology and the Wharton Business School. She is the Director of the Communication Neuroscience Lab and the Climate Communication Division in the Annenberg Public Policy Center.

Danielle Cosme is the Scientific Director of the Climate Communication Division at the Annenberg Public Policy Center and a Senior Researcher in the Communication Neuroscience Lab, University of Pennsylvania.

References

Ad Council. (2020). Driving Voter Turnout in 2020: Research on Effective Messaging Strategies for Each Generation. Ad Council Org. Retrieved September 23, 2025, from https://www.adcouncil.org/learn-with-us/ad-council-research-institute/vote-2020-project

Ajzen, I., Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Albarracín, D., Fayaz-Farkhad, B., & Granados Samayoa, J. A. (2024). Determinants of behaviour and their efficacy as targets of behavioural change interventions. Nature Reviews Psychology, 1–16. https://doi.org/10.1038/s44159-024-00305-0

Alliance for Justice. (2024, April 11). Nonpartisan GOTV Efforts – Can We Say That? Alliance for Justice. https://afj.org/article/nonpartisan-gotv-efforts-can-we-say-that/

Anyon, Y., Bender, K., Kennedy, H., & Dechants, J. (2018). A Systematic Review of Youth Participatory Action Research (YPAR) in the United States: Methodologies, Youth Outcomes, and Future Directions. Health Education & Behavior, 45(6), 865–878. https://doi.org/10.1177/1090198118769357

Apau, D., Suzuki, S., Medina, A., Booth, R.B. (March, 2025). *How Does Gen Z Feel About Democracy? Insights from Three profiles of Youth and Democracy*. CIRCLE (Center for Information & Research on Civic Learning and Engagement) & Protect Democracy.

Bali, V. A., Robison, L. J., & Winder, R. (2020). What Motivates People to Vote? The Role of Selfishness, Duty, and Social Motives When Voting. Sage Open, 10(4). https://doi.org/10.1177/2158244020950376

Bennion, E. A., & Nickerson, D. W. (2016). I Will Register and Vote, If You Teach Me How: A Field Experiment Testing Voter Registration in College Classrooms. *PS: Political Science & Politics, 49*(4), 867–871. doi:10.1017/S1049096516001360

Bennion, E. A., & Michelson, M. R. (2023). Educating Students for Democracy: What Colleges Are Doing, How It's Working, and What Needs to Happen Next. *The ANNALS of the American Academy of Political and Social Science, 705*(1), 95-115. https://doi.org/10.1177/00027162231188567

Bergan, D.E., Carnahan, D., Lajevardi, N. et al. (2021). Promoting the Youth Vote: The Role of Informational Cues and Social Pressure. *Polit Behav 44*, 2027–2047. https://doi.org/10.1007/s11109-021-09686-x

Blais, A., Daoust, J. (2020). The Motivation to Vote: Explaining Electoral Participation. Canada: UBC Press.

Brandt, M. J. (2022). Measuring the belief system of a person. *Journal of Personality and Social Psychology*, 123(4), 830–853. https://doi.org/10.1037/pspp0000416

Brandt, M. J., & Sleegers, W. W. A. (2021). Evaluating belief system networks as a theory of political belief system dynamics. *Personality and Social Psychology Review, 25*(2), 159–185. https://doi.org/10.1177/1088868321993751

Brennan, E., Gibson, L., Momjian, A., & Hornik, R. (2013). Identifying potential target beliefs for a youth-focused smoking prevention mass media campaign: Final findings and recommendations for 13-17 year old non-smokers (*CECCR Working Paper Series 383*). Philadelphia, PA: Penn's Center of Excellence in Cancer Communication Research, Annenberg School for Communication, University of Pennsylvania.

Bryan, C.J., Walton, G.M., Rogers, T., Dweck, C.S. (2011). Motivating voter turnout by invoking the self. *Proc. Natl. Acad. Sci. U.S.A. 108*(31), 12653-12656. https://doi.org/10.1073/pnas.1103343108

Burgess, D., Haney, B., Snyder, M., Sullivan, J.L., Transue, J.E. (2000). Rocking the Vote: Using Personalized Messages to Motivate Voting among Young Adults. *Public Opinion Quarterly, 64*(1), 29–52. https://doi.org/10.1086/316758

Cappella, J.N. (2006). Integrating Message Effects and Behavior Change Theories: Organizing Comments and Unanswered Questions. *Journal of Communication 56*(1), 265-279. DOI: 10.1111/j.1460-2466.2006.00293.x

[CIRCLE 2022]. Medina, A., de Guzman, P., Siegel-Stechler, K., & Beadle, K. (2022, December 19; updated March 14, 2023). Youth in 2022: Concerned about issues but neglected by campaigns. Center for Information & Research on Civic Learning and Engagement (CIRCLE), Tisch College, Tufts University. https://circle.tufts.edu/latest-research/youth-2022-concerned-about-issues-neglected-campaigns

[CIRCLE, 2023a]. Booth, R. B., Medina, A., Siegel-Stechler, K., & Kiesa, A. (2023, January 30). Youth are interested in political action, but lack support and opportunities. Center for Information & Research on Civic Learning and Engagement (CIRCLE), Tisch College, Tufts University. https://circle.tufts.edu/latest-research/youth-are-interested-political-action-lack-support-and-opportunities

[CIRCLE, 2023b]. Center for Information & Research on Civic Learning and Engagement. (2023). The Youth Vote in 2022. CIRCLE, Jonathan M. Tisch College of Civic Life, Tufts University. Retrieved September 1, 2025, from https://circle.tufts.edu/2022-election-center

[CIRCLE, 2025a]. Medina, A., Siegel-Stechler, K., & Suzuki, S. (2025, January 15). Young people and the 2024 election: Struggling, disconnected, and dissatisfied. Center for Information & Research on Civic Learning and Engagement (CIRCLE), Tisch College, Tufts University. https://circle.tufts.edu/index.php/latest-research/2024-poll-barriers-issues-economy

[CIRCLE, 2025b]. Medina, A., & Hilton, K. (2025, April 14). New data: Nearly half of youth voted in 2024. Center for Information & Research on Civic Learning and Engagement (CIRCLE), Tisch College, Tufts University. https://circle.tufts.edu/latest-research/new-data-nearly-half-youth-voted-2024

Condon, M. and Holleque, M. (2013). Entering Politics. *Political Psychology, 34:* 167-181. https://doi.org/10.1111/pops.12019

Cornish, F., Breton, N., Moreno-Tabarez, U. et al. (2023). Participatory action research. Nat Rev Methods Primers 3(34). https://doi.org/10.1038/s43586-023-00214-1

Cosme, D., Lydic, K., Reinero, D. A., Sinclair, A. H., & Falk, E. B. (Under review). Motivating and supporting youth to vote using theory-driven approaches.

Cosme, D., Chan, H.-Y., Sinclair, A. H., Benitez, C., Lydic, K., Martin, R. E., Resnick, A., Carreras-Tartak, J., Cooper, N., Paul, A. M., Koelle, D., McVay, J., Falk, E. B., & Scholz, C. (2025). Perceived self and social relevance of content motivates news sharing across cultures and topics. PNAS Nexus, 4(2), pgaf019. https://doi.org/10.1093/pnasnexus/pgaf019

Cosme, D., Scholz, C., Chan, H.-Y., Doré, B. P., Pandey, P., Carreras-Tartak, J., Cooper, N., Paul, A., Burns, S. M., & Falk, E. B. (2023). Message self and social relevance increases intentions to share content: Correlational and causal evidence from six studies. Journal of Experimental Psychology: General, 152(1), 253–267. https://doi.org/10.1037/xge0001270

Costa M, Schaffner BF, Prevost A (2018). Walking the walk? Experiments on the effect of pledging to vote on youth turnout. *PLoS ONE 13*(5): e0197066. https://doi.org/10.1371/journal.pone.0197066

Csárdi, G., Nepusz, T., Traag, V., Horvát, S., Zanini, F., Noom, D., & Müller, K. (2006). igraph: Network Analysis and Visualization (p. 2.1.4) [Dataset]. https://doi.org/10.32614/CRAN.package.igraph

Dablander, F., & Hinne, M. (2019). Node centrality measures are a poor substitute for causal inference. *Scientific reports, 9*(1), 6846. https://doi.org/10.1038/s41598-019-43033-9

Delli Carpini, M. X. (2000). Gen.com: Youth, Civic Engagement, and the New Information Environment. *Political Communication*, *17*(4), 341–349. https://doi.org/10.1080/10584600050178942

Epskamp, S., Cramer, A.O.J., Waldorp, L.J., Schmittmann, V.D., Borsboom, D. (2012). Ggraph: Network Visualizations of Relationships in Psychometric Data. *Journal of Statistical Software 48*(4), 1–18. https://doi.org/10.18637/jss.v048.i04

Falk, E., & Scholz, C. (2018). Persuasion, Influence, and Value: Perspectives from Communication and Social Neuroscience. Annual Review of Psychology, 69(1), 329–356. https://doi.org/10.1146/annurev-psych-122216-011821

Feldman, L., Pasek, J., Romer, D., Hall Jamieson, K. (2007). Identifying Best Practices in Civic Education: Lessons from the Student Voices Program. *American Journal of Education 114*(1). https://doi.org/10.1086/520692

Fishbein, M., & Cappella, J. N. (2006). The Role of Theory in Developing Effective Health Communications. Journal of Communication, 56(Suppl 1), S1–S17. https://doi.org/10.1111/j.1460-2466.2006.00280.x

Fishbein, M. & Ajzen, I. (2010). *Predicting and changing behavior: The Reasoned Action Approach.* New York: Taylor & Francis.

Fishbein, M. and Ajzen, I. (1975). *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*. Addison-Wesley Publishing Co, Inc., Boston.

French Bourgeois, L., & de la Sablonnière, R. (2023). Realigning individual behavior with societal values: The role of planning in injunctive-norm interventions aimed at increasing voter turnout. Analyses of Social Issues and Public Policy, 23(1), 155–173. https://doi.org/10.1111/asap.12332

Friedman, J., Hastie, T., Tibshirani, R. (2008). Sparse inverse covariance estimation with the graphical lasso, Biostatistics 9(3), 432–441. https://doi.org/10.1093/biostatistics/kxm045

Gerber, A. S., & Green, D. P. (2017). Chapter 9 - Field Experiments on Voter Mobilization: An Overview of a Burgeoning Literature. In A. V. Banerjee & E. Duflo (Eds.), Handbook of Economic Field Experiments (Vol. 1, pp. 395–438). North-Holland. https://doi.org/10.1016/bs.hefe.2016.09.002

Gerber, A. S., Green, D. P., & Larimer, C. W. (2008). Social Pressure and Voter Turnout: Evidence from a Large-Scale Field Experiment. American Political Science Review, 102(1), 33–48. https://doi.org/10.1017/S000305540808009X

Gerber, A.S., Huber, G.A., Biggers, D.R., Hendry, D.J. (2016). A field experiment shows that subtle linguistic cues might not affect voter behavior. *Proc. Natl. Acad. Sci. U.S.A. 113*(26), 7112-7117. https://doi.org/10.1073/pnas.1513727113

Glasford, D.E. (2008). Predicting Voting Behavior of Young Adults: The Importance of Information, Motivation, and Behavioral Skills. *Journal of Applied Social Psychology, 38,* 2648-2672. https://doi.org/10.1111/j.1559-1816.2008.00408.x

Glynn, C. J., Huge, M. E., & Lunney, C. A. (2009). The Influence of Perceived Social Norms on College Students' Intention to Vote. *Political Communication, 26*(1), 48–64. https://doi.org/10.1080/10584600802622860

Green, D. P., & Vavreck, L. (2006). Assessing the turnout effects of Rock the Vote's 2004 television commercials: A randomized field experiment. In *Annual Meeting of the Midwest Political Science Association*, Chicago, IL.

Haenschen, K., & and Jennings, J. (2019). Mobilizing Millennial Voters with Targeted Internet Advertisements: A Field Experiment. Political Communication, 36(3), 357–375. https://doi.org/10.1080/10584609.2018.1548530

Harder, J., & Krosnick, J. A. (2008). Why do people vote? A psychological analysis of the causes of voter turnout. Journal of Social Issues, 64(3), 525-549.

Hoffman, M., Steinley, D., Gates, K. M., Prinstein, M. J., & Brusco, M. J. (2017). Detecting Clusters/Communities in Social Networks. Multivariate Behavioral Research, 53(1), 57–73. https://doi.org/10.1080/00273171.2017.1391682

Holbein, J. B., & Hillygus, D. S. (2020). Making young voters: Converting civic attitudes into civic action. Cambridge University Press.

Hornik, R. C., Volinsky, A. C., Mannis, S., Gibson, L. A., Brennan, E., Lee, S. J., & Tan, A. S. L. (2018). Validating the Hornik & Woolf approach to choosing media campaign themes: Do promising beliefs predict behavior change in a longitudinal study? Communication Methods and Measures, 13(1), 60–68. https://doi.org/10.1080/19312458.2018.1515902

Hornik R, & Woolf KD (1999). Using cross-sectional surveys to plan message strategies. Social Marketing Quarterly, 5(34), 34–41. doi: 10.1080/15245004.1999.9961044

Howard, L. A., & Posler, B. D. (2012). Reframing Political Messages: Using a Festival to Reach Young Voters. *Journal of Political Science Education, 8*(4), 389–407. https://doi.org/10.1080/15512169.2012.729446

Huber, G. A., Gerber, A. S., Biggers, D. R., & Hendry, D. J. (2022). Can Raising the Stakes of Election Outcomes Increase Participation? Results from a Large-Scale Field Experiment in Local Elections.

British Journal of Political Science, 52(4), 1635–1650. https://doi.org/10.1017/S0007123421000600

Jameson-Charles, M., Charles, W. H. (2022). Youth Mobilising Youth to Vote: An Examination of a Youth-Led Voter Education Initiative in Guyana. In Gilbert-Roberts, T.A. (Ed.) *Youth Participation in the Caribbean: Politics and Development (1st edition)*. doi: 10.4324/9781003203889-10

Kawashima-Ginsberg, K., Kiesa, A. (2019). Getting Young People to Vote: Seven Tips for the Classroom. *Social Education 83*(4), p. 194–199.

Keating, D.M. (2024). Persuasive message effects via activated and modified belief clusters: toward a general theory. Human Communication Research 50(2), 299-308.

Kikut-Stein, A., Givan, K., Branson, P., Fishman, J., Bailey, K., Paolicelli, M., … Tan, A. (2024a). Youth Participatory Action Communication Research: A Model for Developing Youth-Driven Health Campaigns. *Health Communication, 40*(6), 1062–1077. https://doi.org/10.1080/10410236.2024.2386713

Kikut-Stein, A., Givan, K., Fishman, J. Blanco-Liz, A. Alvarez-Sanchez, D., Fletcher, J., Gambrell, R., Hernandez, A., Richardson, C., Shaw, A., von Oiste, J.J. (2024b). Integrating youth participatory action research and health communication to inform youth and young adult covid-19 vaccine communication research. *Health Education Research 39*(5), 411–425. https://doi.org/10.1093/her/cyae026

Knight, S., Peterson, D.A.M. (2022). Pre-adult political experiences and political participation. *The Social Science Journal*. DOI: 10.1080/03623319.2022.2097854

Knoester, M., Kretz, L. (2017). Why do young adults vote at low rates? Implications for education. *Social Studies Research and Practice 12*(2): 139–153. https://doi.org/10.1108/SSRP-04-2017-0013

Knoester, M., Gichiru, W. P. (2021). Inquiry into the Educational Implications of Voting Practices of Young Adults in U.S. Mid-Term Elections*, **. *The Journal of Social Studies Research, 45*(4), 267-276. https://doi.org/10.1016/j.jssr.2021.05.003

Kraitzman, A. P., DeMora ,Stephanie L., & and Albarracín, D. (2025). Motivating Future Voters: Comparing the Effects of 'I Voted' and 'I Will Vote' Stickers on Intention to Vote. Political Communication, 0(0), 1–17. https://doi.org/10.1080/10584609.2025.2472768

Lee, S.J., Brennan, E., Gibson, L.A., Tan, A.S.L., Kybert-Momjian, A., Liu, J. Hornik, R. (2016). Predictive Validity of an Empirical Approach for Selecting Promising Message Topics: A Randomized-Controlled Study, *Journal of Communication 66*(3), 433–453. https://doi.org/10.1111/jcom.12227

LeRoux, K., Langer, J. & Plotner, S. (2023). Nonprofit Messaging and the 2020 Election: Findings from a Nonpartisan Get-Out-The-Vote (GOTV) Field Experiment. *Nonprofit Policy Forum, 14*(2), 157-183. https://doi.org/10.1515/npf-2021-0062

Levy, B.L.M., Akiva, T. (2019). Motivating Political Participation Among Youth: An Analysis of Factors

Related to Adolescents' Political Engagement. *Political Psychology, 40*: 1039-1055. https://doi.org/10.1111/pops.12578

Lydic, K., Falk, E. B., Delli Carpini, M. X., Cooper, N., Dym, A., & Cosme, D. (2025, July 3). Autonomy as civic motivation: Associations between autonomy and civic duty, civic action, and voting. https://doi.org/10.31234/osf.io/4bcq2_v1

Maiello, C., Oser, F., Biedermann, H. (2003). Civic Knowledge, Civic Skills and Civic Engagement. *European Educational Research Journal 2*(3).

Mansbridge, J. (2019). Representation, legitimacy, and innovation. *Journal of Chinese Governance, 4*(4), 299–322. https://doi.org/10.1080/23812346.2019.1672361

Martin, A. (2012). *Young people and politics: Political engagement in the anglo-american democracies.* Taylor & Francis Group.

Martinez, J. L., Latimer, A. E., Rivers, S. E., & Salovey, P. (2012). Formative research for a community-based message-framing intervention. *American journal of health behavior, 36*(3), 335–347. https://doi.org/10.5993/AJHB.36.3.5

McDevitt, M., & Chaffee, S. (2000). Closing Gaps in Political Communication and Knowledge: Effects of a School Intervention. *Communication Research, 27*(3), 259-292. https://doi.org/10.1177/009365000027003001

Mckinney, M. S., & Banwart, M. C. (2005). Rocking the Youth Vote Through Debate: examining the effects of a citizen versus journalist controlled debate on civic engagement. *Journalism Studies, 6*(2), 153–163. https://doi.org/10.1080/14616700500057171

Michelson, M. R., & Ostfeld, M. (2024). Chapter 8: From concept to implementation: Engaging student researchers in get-out-the-vote field experiments. https://www.elgaronline.com/edcollchap/book/9781802208795/book-part-9781802208795-17.xml

Nickerson, D.W., & Rogers, T. (2010). Do You Have a Voting Plan? *Psychological Science, 21*, 194 - 199.

Nickerson, D. W. (2006). Hunting the Elusive Young Voter. *Journal of Political Marketing, 5*(3), 47–69. https://doi.org/10.1300/J199v05n03_03

Nonprofit VOTE. (2024). Voter Engagement Guide. https://www.nonprofitvote.org/wp-content/uploads/2024/10/Nonprofit-VOTE-Nonpartisan-Voter-Engagement-toolkit-2024.pdf

Orr, S., & Hoover, M. (Eds.). (2007). Youth political engagement: why rock the vote hits the wrong note. In Shea & Green (Eds.), *Fountain of youth : strategies and tactics for mobilizing America's young voters.* Bloomsbury Publishing.

Ozer, E.J., Piatt, A.A. (2018). Youth-led Participatory Action Research: Principles, Implementation, and

Diffusion in Diverse Settings. In N. Wallerstein, B. Duran, J. Oetzel, & M. Minkler (Eds.) *Community-Based Participatory Research for Health (3rd edition)*. San Francisco, CA: Jossey-Bass.

Ozer, E., Abraczinskas, M., Suleiman, A., Kennedy, H., & Nash, A. (2024). Youth-Led Participatory Action Research and Developmental Science: Intersections and Innovations. *Annual Review of Developmental Psychology, 6*(1), 401-423. http://dx.doi.org/10.1146/annurev-devpsych-010923-100158

Panagopoulos, C. (2010). Affect, Social Pressure and Prosocial Motivation: Field Experimental Evidence of the Mobilizing Effects of Pride, Shame and Publicizing Voting Behavior. Political Behavior, 32(3), 369–386. https://doi.org/10.1007/s11109-010-9114-0

Pew Research Center (2018). The Public, the Political System and American Democracy. Accessed Oct. 30, 2024 from https://www.pewresearch.org/politics/2018/04/26/the-public-the-political-system-and-american-democracy/

Pew Research Center (2022). Majority of Public Disapproves of Supreme Court's Decision To Overturn Roe v. Wade. Accessed Oct. 30, 2024 from https://www.pewresearch.org/politics/2022/07/06/majority-of-public-disapproves-of-supreme-courts-decision-to-overturn-roe-v-wade/

Pew (2023a). Republican Gains in 2022 Midterms Driven Mostly by Turnout Advantage. *Pew Research Center.* Accessed Dec. 14, 2024 from: https://www.pewresearch.org/politics/2023/07/12/republican-gains-in-2022-midterms-driven-mostly-by-turnout-advantage/

Pew Research Center (2023b). Americans' Dismal Views of the Nation's Politics. Accessed Oct. 30, 2024 from https://www.pewresearch.org/politics/2023/09/19/americans-dismal-views-of-the-nations-politics/

Pleasant, A., O'Leary, C., & Carmona, R. H. (2020). Using formative research to tailor a community intervention focused on the prevention of chronic disease. *Evaluation and program planning, 78*. https://doi.org/10.1016/j.evalprogplan.2019.101716

Pons, P., Latapy, M. (2005). Computing Communities in Large Networks Using Random Walks. In: Yolum, p., Güngör, T., Gürgen, F., Özturan, C. (eds) Computer and Information Sciences. ISCIS 2005. Lecture Notes in Computer Science, vol 3733. Springer, Berlin, Heidelberg. https://doi.org/10.1007/11569596_31

Quintana, R. (2023). From single attitudes to belief systems: Examining the centrality of STEM attitudes using belief network analysis. International Journal of Educational Research 119. https://doi.org/10.1016/j.ijer.2023.102179

Richards, W. (2012). "Increasing the Youth Vote: Communication Strategies for Nonprofits". *Communication Honors Thesis*. https://digitalcommons.trinity.edu/comm_honors/4

Rogers, T., Green, D. P., Ternovski, J., & Ferrerosa Young, C. (2017). Social pressure and voting: A field experiment conducted in a high-salience election. Electoral Studies, 46, 87–100. https://doi.org/10.1016/j.electstud.2017.02.004

Syvertsen, A.K., Stout, M.D., Flanagan, C.A., Mitra, D.L., Oliver, M.B., Sundar, S. S. (2009). Using Elections as Teachable Moments: A Randomized Evaluation of the Student Voices Civic Education Program. *American Journal of Education 116*(1). https://doi.org/10.1086/605100

Teo, T (2013). 'Digital Nativity': A Definitional Framework. *World Journal on Educational Technology 5*(3), 389- 394.

Teresi, H., Michelson, M.R. (2015). Wired to mobilize: The effect of social networking messages on voter turnout. *The Social Science Journal 52*(2), 195-204. https://doi-org.proxy.library.upenn.edu/10.1016/j.soscij.2014.09.004

Turner-Zwinkels, F. M., & Brandt, M. J. (2022). Belief system networks can be used to predict where to expect dynamic constraint. *Journal of Experimental Social Psychology, 100*, 104279. https://doi.org/10.1016/j.jesp.2021.104279

Turner-Zwinkels, F. M., Johnson, B. B., Sibley, C. G., & Brandt, M. J. (2021). Conservatives' Moral Foundations Are More Densely Connected Than Liberals' Moral Foundations. Personality and Social Psychology Bulletin, 47(2), 167–184. https://doi.org/10.1177/0146167220916070

Unan, A., John, P., Foos, F., & Cheng-Matsuno, V. (2024). Null effects of social media ads on voter registration: Three digital field experiments. *Research & Politics, 11*(1). https://doi.org/10.1177/20531680231225316

Vlasceanu, M., Dyckovsky, A. M., & Coman, A. (2024). A Network Approach to Investigate the Dynamics of Individual and Collective Beliefs: Advances and Applications of the BENDING Model. *Perspectives on Psychological Science, 19*(2), 444-453. https://doi.org/10.1177/17456916231185776

Vlasceanu, M., McMahon, C. E., Van Bavel, J. J., & Coman, A. (2023). Political and nonpolitical belief change elicits behavioral change. Journal of Experimental Psychology: Applied, 29(3), 467–476. https://doi.org/10.1037/xap0000455

Yang, S., Shen, L., Gregory, S., Probst, B., Farrar-Edwards, D., & Passmore, S. R. (2023). Applying the Hornik & Woolf Approach to Identify Messaging Themes and Improve COVID-19 Vaccine Confidence Among Federally Qualified Health Centers' Workforce in Wisconsin. *Journal of Health Communication, 28*(8), 507–525. https://doi-org.proxy.library.upenn.edu/10.1080/10810730.2023.2230929

Zhao, X., Strasser, A., Cappella, J. N., Lerman, C., & Fishbein, M. (2011). A Measure of Perceived Argument Strength: Reliability and Validity. *Communication Methods and Measures*, *5*(1), 48–75. https://doi.org/10.1080/19312458.2010.547822

Zukin, C. (2006). *A new engagement?: Political participation, civic life, and the changing American citizen.* Oxford university press.

1
2
3
4
5

Supplementary Materials

Study 1: Formative research on voting beliefs

List of beliefs

The full list of beliefs used in Study 1 are listed in Table S1.

Table S1

Beliefs included in the formative research survey

Belief	Text	Valence
1	The outcome of the election will affect my rights and freedoms	Neutral
2	The outcome of the election will affect the rights and freedoms of people I care about	Neutral
3	The outcome of the election will impact the future of our country	Neutral
4	The outcome of the election will impact my local community	Neutral
5	There is a lot at stake for me personally in the election	Neutral
6	There is a lot at stake for people I care about in the election	Neutral
7	Voting impacts policies and other outcomes I care about	Neutral
8	Voting is my duty	Positive
9	The act of voting is important regardless of the outcome	Positive
10	Voting is an important part of being civically engaged	Positive
11	Voting is an important way to participate in democracy	Positive
12	Voting is my right	Positive
13	Voting is a way I can express my voice about issues I care about	Positive
14	Voting is a way I can advance the causes I care about	Positive
15	Voting is consistent with my core values	Positive
16	Voting allows me to be a part of something bigger than myself	Positive
17	Voting can contribute to building a better world	Positive
18	Voting makes me feel like I'm part of a community	Positive
19	Voting makes me feel connected to others	Positive
20	Voting is a way I can speak up for others	Positive
21	Even if I vote, nothing will change for people like me	Negative
22	It doesn’t matter if I personally vote	Negative
23	No one will care whether or not I vote	Negative
24	The system is too broken to be fixed by voting	Negative
25	Because of where I live and vote, my vote doesn't matter	Negative
26	I am not qualified or knowledgeable enough to make decisions about items on the ballot	Negative
27	If I don't like the candidates, it's not worth voting	Negative
28	It's too difficult or effortful to make a plan to vote	Negative
29	It's too difficult or effortful to find out how to register to vote	Negative
30	It's too difficult or effortful to find out how cast my ballot (in person or by mail)	Negative
31	Voting is risky (to my health, safety, well-being)	Negative
32	I don’t think I will have time to learn about what is on the ballot	Negative
33	I don’t think I will have time to vote	Negative
34	Voting is not important to me	Negative

35	Not voting is a form of self-expression	Negative
36	Voting is relevant to me personally	Positive
37	Voting is relevant to people I know	Positive

Results

The number of people who either strongly hold a belief ("yes") or don't ("no") and the percent to move (i.e., the percent of people who do not strongly hold a belief) is listed in Table S2. Mean belief strength as a function of group (intenders and non-intenders), mean differences between groups, correlation between belief strength and voting intentions, percentage of people with strong voting intentions in each group, and the percentage to gain for all beliefs are listed in Table S3.

Table S2

Number of people who strongly hold a belief and percent to move

	Strongly held		
Belief	No	Yes	$\%_{move}$
The system is too broken to be fixed by voting	234	40	85.4
Voting makes me feel connected to others	231	43	84.3
Voting makes me feel like I'm part of a community	229	45	83.6
Even if I vote, nothing will change for people like me	222	52	81.0
Not voting is a form of self-expression	219	55	79.9
There is a lot at stake for me personally in the election	208	66	75.9
I don't think I will have time to learn about what is on the ballot	206	68	75.2
No one will care whether or not I vote	200	74	73.0
Voting is a way I can speak up for others	197	76	72.2
Voting is a way I can advance the causes I care about	196	78	71.5
I am not qualified or knowledgeable enough to make decisions about items on the ballot	195	79	71.2
It's too difficult or effortful to find out how cast my ballot (in person or by mail)	190	84	69.3
The outcome of the election will impact my local community	190	84	69.3
Voting allows me to be a part of something bigger than myself	189	85	69.0
It's too difficult or effortful to find out how to register to vote	185	89	67.5
Voting is a way I can express my voice about issues I care about	185	89	67.5
It doesn't matter if I personally vote	182	91	66.7
It's too difficult or effortful to make a plan to vote	182	92	66.4
Voting is consistent with my core values	181	92	66.3
If I don't like the candidates, it's not worth voting	178	96	65.0
Voting is my duty	176	98	64.2
Because of where I live and vote, my vote doesn't matter	173	101	63.1
The act of voting is important regardless of the outcome	172	102	62.8
Voting is relevant to me personally	171	103	62.4
Voting can contribute to building a better world	169	105	61.7
There is a lot at stake for people I care about in the election	168	106	61.3
Voting is relevant to people I know	160	114	58.4
Voting is not important to me	159	115	58.0
The outcome of the election will affect my rights and freedoms	156	118	56.9
I don't think I will have time to vote	154	120	56.2

Voting is an important part of being civically engaged	154	120	56.2
Voting impacts policies and other outcomes I care about	153	121	55.8
The outcome of the election will affect the rights and freedoms of people I care about	146	128	53.3
Voting is an important way to participate in democracy	143	131	52.2
Voting is risky (to my health, safety, well-being)	139	135	50.7
The outcome of the election will impact the future of our country	120	154	43.8
Voting is my right	78	196	28.5

1

Table S3

Results for all beliefs

Belief text	$M_{intender}$	$M_{non\text{-}intender}$	$M_{intender - non\text{-}intender}$ [95% CI]	r [95% CI]	$\%_{intender}$	$\%_{non\text{-}intender}$	$\%_{gain}$
It doesn't matter if I personally vote	2.01	4.05	-2.04 [-2.40, -1.69]	-0.61 [-0.68, -0.53]	98.9	1.1	28.5
Voting is consistent with my core values	6.09	4.68	1.41 [1.09, 1.73]	0.55 [0.47, 0.63]	97.8	2.2	27.4
The system is too broken to be fixed by voting	3.12	4.42	-1.30 [-1.71, -0.89]	-0.36 [-0.46, -0.25]	97.5	2.5	27.1
Voting is not important to me	1.54	3.43	-1.89 [-2.22, -1.55]	-0.71 [-0.77, -0.65]	97.4	2.6	27
It's too difficult or effortful to find out how to register to vote	2.07	3.56	-1.48 [-1.85, -1.11]	-0.35 [-0.45, -0.24]	96.6	3.4	26.2
Voting is relevant to me personally	6.15	4.48	1.67 [1.29, 2.05]	0.58 [0.50, 0.66]	96.1	3.9	25.7
It's too difficult or effortful to make a plan to vote	1.95	3.37	-1.42 [-1.75, -1.09]	-0.41 [-0.50, -0.30]	95.7	4.3	25.3
Voting makes me feel like I'm part of a community	5.21	4.01	1.19 [0.79, 1.60]	0.40 [0.30, 0.50]	95.6	4.4	25.2
There is a lot at stake for me personally in the election	5.47	4.07	1.40 [0.98, 1.81]	0.41 [0.31, 0.51]	95.5	4.5	25.1
Voting makes me feel connected to others	4.96	3.86	1.09 [0.69, 1.50]	0.35 [0.24, 0.45]	95.3	4.7	24.9
Even if I vote, nothing will change for people like me	2.74	3.98	-1.24 [-1.65, -0.83]	-0.41 [-0.51, -0.31]	94.2	5.8	23.8
Voting allows me to be a part of something bigger than myself	6.02	4.78	1.24 [0.88, 1.60]	0.51 [0.42, 0.59]	94.1	5.9	23.7
The act of voting is important regardless of the outcome	6.11	4.77	1.34 [0.97, 1.72]	0.49 [0.39, 0.57]	94.1	5.9	23.7
It's too difficult or effortful to find out how cast my ballot (in person or by mail)	2.07	3.78	-1.71 [-2.06, -1.35]	-0.45 [-0.54, -0.35]	94	6	23.6
Voting is my duty	6.12	4.54	1.58 [1.20, 1.95]	0.56 [0.47, 0.63]	93.9	6.1	23.5
Voting is a way I can advance the causes I care about	6.05	4.98	1.07 [0.75, 1.40]	0.42 [0.32, 0.51]	93.6	6.4	23.2
Voting is a way I can speak up for others	5.85	4.79	1.07 [0.70, 1.43]	0.37 [0.26, 0.47]	93.4	6.6	23
Because of where I live and vote, my vote doesn't matter	2.14	3.67	-1.53 [-1.97, -1.08]	-0.43 [-0.52, -0.33]	93.1	6.9	22.7
The outcome of the election will impact my local community	5.87	4.63	1.24 [0.84, 1.63]	0.42 [0.32, 0.52]	92.9	7.1	22.5
Not voting is a form of self-expression	3.02	4.36	-1.34 [-1.80, -0.89]	-0.26 [-0.37, -0.15]	92.7	7.3	22.3

There is a lot at stake for people I care about in the election	6.18	4.77	1.42 [1.04, 1.79]	0.51 [0.42, 0.60]	92.5	7.5	22.1
I am not qualified or knowledgeable enough to make decisions about items on the ballot	2.17	3.84	-1.67 [-2.09, -1.25]	-0.46 [-0.55, -0.36]	92.4	7.6	22
Voting is a way I can express my voice about issues I care about	6.05	4.72	1.34 [0.98, 1.69]	0.49 [0.39, 0.57]	92.1	7.9	21.7
No one will care whether or not I vote	2.18	3.62	-1.44 [-1.83, -1.05]	-0.45 [-0.54, -0.35]	91.9	8.1	21.5
Voting is an important part of being civically engaged	6.42	5.49	0.93 [0.66, 1.19]	0.43 [0.32, 0.52]	91.7	8.3	21.3
I don't think I will have time to vote	1.63	3.36	-1.73 [-2.08, -1.38]	-0.50 [-0.59, -0.41]	91.7	8.3	21.3
I don't think I will have time to learn about what is on the ballot	2.4	3.98	-1.57 [-1.98, -1.16]	-0.41 [-0.50, -0.31]	91.2	8.8	20.8
If I don't like the candidates, it's not worth voting	1.96	3.74	-1.78 [-2.17, -1.38]	-0.53 [-0.61, -0.44]	90.6	9.4	20.2
Voting is relevant to people I know	6.36	5.2	1.16 [0.85, 1.47]	0.47 [0.37, 0.56]	90.4	9.6	20
Voting impacts policies and other outcomes I care about	6.39	5.32	1.07 [0.77, 1.38]	0.56 [0.47, 0.63]	90.1	9.9	19.7
Voting can contribute to building a better world	6.24	5.26	0.98 [0.67, 1.29]	0.42 [0.32, 0.51]	88.6	11.4	18.2
Voting is an important way to participate in democracy	6.44	5.47	0.97 [0.67, 1.26]	0.49 [0.39, 0.57]	87.8	12.2	17.4
The outcome of the election will affect my rights and freedoms	6.11	4.8	1.31 [0.90, 1.73]	0.46 [0.36, 0.55]	87.3	12.7	16.9
The outcome of the election will affect the rights and freedoms of people I care about	6.3	5.3	1.00 [0.66, 1.35]	0.46 [0.37, 0.55]	86.7	13.3	16.3
Voting is risky (to my health, safety, well-being)	1.59	2.68	-1.09 [-1.45, -0.74]	-0.35 [-0.45, -0.24]	85.9	14.1	15.5
The outcome of the election will impact the future of our country	6.55	5.52	1.04 [0.70, 1.37]	0.48 [0.38, 0.56]	85.1	14.9	14.7
Voting is my right	6.8	6.22	0.58 [0.38, 0.78]	0.39 [0.29, 0.49]	81.6	18.4	11.2

Note. Negative beliefs are only reverse-scored for the percent metrics (i.e. percent intenders and non-intenders, and percentage to gain).

Correlations between belief centrality and percentage to gain

The correlation between belief centrality and percentage to gain reported in the main manuscript is visualized in Figure S1.

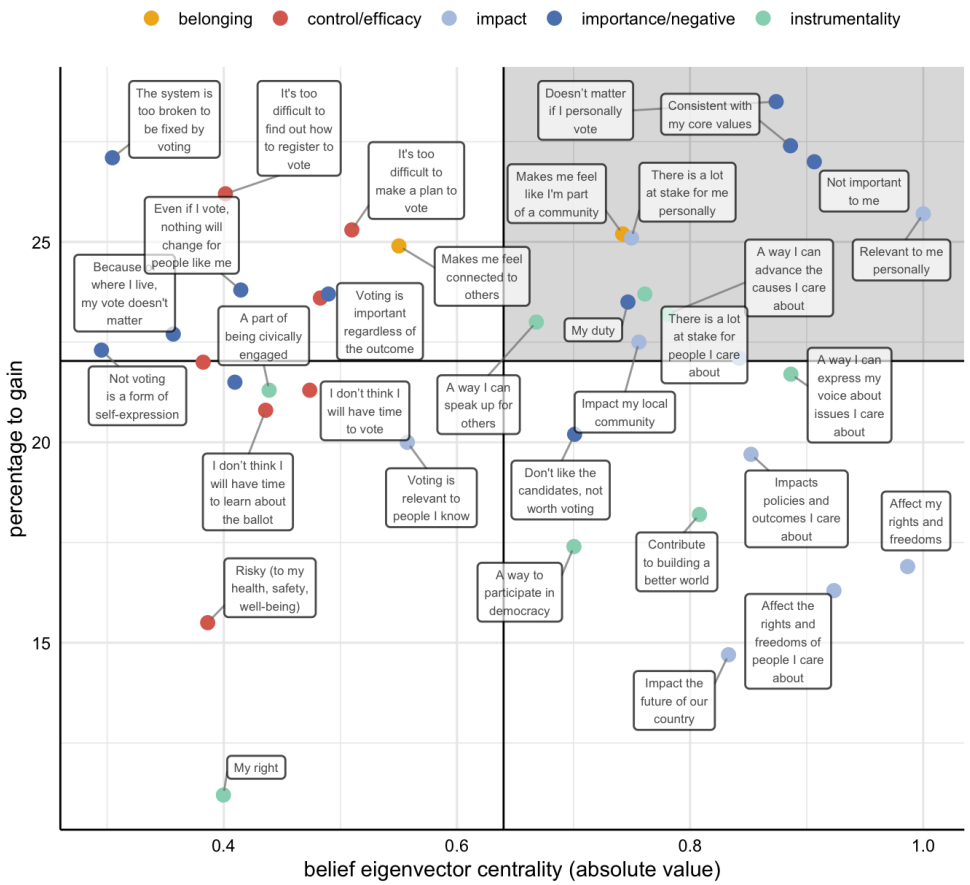

Figure S1. Relationship between belief centrality and percentage to gain. The vertical and horizontal lines indicate the mean for each axis and the grey rectangle highlights beliefs that are above average for both centrality and percentage to gain.

Correlations with intentions to register and make a plan, and voting attitudes, subjective norms, and perceived behavioral control

Identification of promising beliefs to target in messaging used intentions to vote as the primary outcome of interest. Here we report correlations between each belief and participants' intentions to register to vote among those not already registered (N = 76), and intentions to make a plan to vote, and voting attitudes, subjective norms, and perceived behavioral control in all participants (N = 274).

Table S4

Correlations and 95% confidence intervals between beliefs and intentions to register and make a plan to vote, and voting attitudes, subjective norms, and perceived behavioral control

Belief text	Register	Plan	Attitude	Norms	PBC
The outcome of the election will affect my rights and freedoms	0.35 [0.14, 0.54]	0.38 [0.27, 0.48]	0.39 [0.28, 0.48]	0.38 [0.27, 0.48]	0.24 [0.13, 0.35]
There is a lot at stake for me personally in the election	0.32 [0.10, 0.51]	0.39 [0.29, 0.49]	0.39 [0.28, 0.48]	0.33 [0.22, 0.43]	0.23 [0.12, 0.34]
Voting impacts policies and other outcomes I care about	0.55 [0.37, 0.69]	0.49 [0.39, 0.57]	0.46 [0.36, 0.55]	0.50 [0.40, 0.58]	0.36 [0.26, 0.46]
There is a lot at stake for people I care about in the election	0.41 [0.21, 0.58]	0.49 [0.39, 0.57]	0.40 [0.30, 0.50]	0.48 [0.38, 0.57]	0.22 [0.10, 0.33]

The outcome of the election will impact the future of our country	0.36 [0.15, 0.54]	0.42 [0.32, 0.51]	0.41 [0.31, 0.51]	0.46 [0.37, 0.55]	0.28 [0.17, 0.39]
The outcome of the election will affect the rights and freedoms of people I care about	0.44 [0.24, 0.61]	0.41 [0.31, 0.51]	0.38 [0.27, 0.48]	0.36 [0.25, 0.46]	0.26 [0.14, 0.37]
The outcome of the election will impact my local community	0.34 [0.12, 0.52]	0.34 [0.23, 0.44]	0.33 [0.22, 0.43]	0.42 [0.32, 0.51]	0.23 [0.11, 0.34]
It doesn't matter if I personally vote	-0.55 [-0.69, -0.36]	-0.61 [-0.68, -0.53]	-0.55 [-0.63, -0.47]	-0.49 [-0.57, -0.39]	-0.38 [-0.47, -0.27]
If I don't like the candidates, it's not worth voting	-0.45 [-0.62, -0.26]	-0.45 [-0.54, -0.35]	-0.55 [-0.63, -0.47]	-0.45 [-0.54, -0.35]	-0.29 [-0.39, -0.17]
Because of where I live and vote, my vote doesn't matter	-0.41 [-0.58, -0.20]	-0.39 [-0.48, -0.28]	-0.36 [-0.46, -0.25]	-0.32 [-0.42, -0.21]	-0.37 [-0.47, -0.26]
Even if I vote, nothing will change for people like me	-0.47 [-0.63, -0.27]	-0.37 [-0.47, -0.26]	-0.44 [-0.53, -0.34]	-0.32 [-0.42, -0.21]	-0.22 [-0.33, -0.10]
The system is too broken to be fixed by voting	-0.44 [-0.61, -0.24]	-0.39 [-0.49, -0.29]	-0.52 [-0.60, -0.43]	-0.32 [-0.43, -0.21]	-0.19 [-0.31, -0.08]
Voting is relevant to me personally	0.55 [0.38, 0.69]	0.57 [0.48, 0.64]	0.60 [0.51, 0.67]	0.43 [0.33, 0.52]	0.27 [0.16, 0.38]
Voting is consistent with my core values	0.62 [0.45, 0.74]	0.64 [0.56, 0.71]	0.58 [0.49, 0.65]	0.52 [0.43, 0.60]	0.40 [0.29, 0.49]
Voting is a way I can express my voice about issues I care about	0.50 [0.30, 0.65]	0.51 [0.41, 0.59]	0.62 [0.55, 0.69]	0.42 [0.32, 0.51]	0.30 [0.19, 0.40]
Voting is a way I can advance the causes I care about	0.40 [0.20, 0.58]	0.43 [0.33, 0.52]	0.49 [0.39, 0.57]	0.33 [0.22, 0.43]	0.29 [0.18, 0.39]
Voting is my right	0.22 [-0.01, 0.42]	0.28 [0.17, 0.39]	0.29 [0.18, 0.40]	0.34 [0.23, 0.44]	0.45 [0.35, 0.54]
Voting is not important to me	-0.58 [-0.71, -0.41]	-0.65 [-0.71, -0.57]	-0.62 [-0.69, -0.54]	-0.53 [-0.61, -0.44]	-0.43 [-0.52, -0.33]
Not voting is a form of self-expression	-0.03 [-0.25, 0.20]	-0.24 [-0.35, -0.13]	-0.31 [-0.42, -0.20]	-0.27 [-0.38, -0.16]	-0.14 [-0.25, -0.02]
Voting allows me to be a part of something bigger than myself	0.51 [0.32, 0.66]	0.50 [0.41, 0.59]	0.51 [0.42, 0.59]	0.50 [0.41, 0.59]	0.29 [0.18, 0.40]
Voting can contribute to building a better world	0.44 [0.23, 0.60]	0.44 [0.34, 0.53]	0.51 [0.42, 0.59]	0.42 [0.31, 0.51]	0.39 [0.28, 0.49]
Voting is a way I can speak up for others	0.40 [0.19, 0.57]	0.43 [0.33, 0.52]	0.47 [0.37, 0.55]	0.28 [0.16, 0.38]	0.23 [0.11, 0.34]
I don't think I will have time to vote	-0.22 [-0.43, 0.00]	-0.49 [-0.57, -0.39]	-0.42 [-0.51, -0.32]	-0.37 [-0.47, -0.26]	-0.50 [-0.59, -0.41]
I am not qualified or knowledgeable enough to make decisions about items on the ballot	-0.24 [-0.45, -0.02]	-0.47 [-0.56, -0.37]	-0.39 [-0.48, -0.28]	-0.38 [-0.48, -0.28]	-0.36 [-0.46, -0.26]
It's too difficult or effortful to find out how cast my ballot (in person or by mail)	-0.19 [-0.40, 0.04]	-0.47 [-0.56, -0.37]	-0.38 [-0.47, -0.27]	-0.33 [-0.43, -0.22]	-0.42 [-0.51, -0.31]
I don't think I will have time to learn about what is on the ballot	-0.23 [-0.43, -0.01]	-0.41 [-0.51, -0.31]	-0.34 [-0.44, -0.23]	-0.34 [-0.44, -0.23]	-0.37 [-0.47, -0.26]
It's too difficult or effortful to make a plan to vote	-0.12 [-0.33, 0.11]	-0.40 [-0.50, -0.30]	-0.34 [-0.44, -0.23]	-0.34 [-0.44, -0.23]	-0.47 [-0.56, -0.37]
It's too difficult or effortful to find out how to register to vote	-0.04 [-0.27, 0.18]	-0.38 [-0.48, -0.27]	-0.31 [-0.41, -0.19]	-0.25 [-0.36, -0.14]	-0.39 [-0.49, -0.29]
Voting is risky (to my health, safety, well-being)	-0.11 [-0.33, 0.12]	-0.36 [-0.46, -0.25]	-0.39 [-0.48, -0.28]	-0.40 [-0.49, -0.29]	-0.49 [-0.57, -0.39]
Voting is my duty	0.58 [0.41, 0.71]	0.58 [0.49, 0.65]	0.56 [0.47, 0.64]	0.45 [0.35, 0.54]	0.28 [0.16, 0.38]
The act of voting is important regardless of the outcome	0.61 [0.45, 0.74]	0.45 [0.35, 0.54]	0.57 [0.48, 0.64]	0.41 [0.31, 0.50]	0.31 [0.20, 0.42]
Voting is an important way to participate in democracy	0.41 [0.21, 0.58]	0.51 [0.41, 0.59]	0.47 [0.37, 0.56]	0.36 [0.25, 0.46]	0.41 [0.30, 0.50]
Voting is relevant to people I know	0.28 [0.06, 0.47]	0.42 [0.32, 0.51]	0.41 [0.30, 0.50]	0.52 [0.42, 0.60]	0.29 [0.18, 0.40]

Voting is an important part of being civically engaged	0.30 [0.08, 0.49]	0.41 [0.31, 0.51]	0.45 [0.35, 0.54]	0.38 [0.28, 0.48]	0.25 [0.13, 0.36]
Voting makes me feel like I'm part of a community	0.52 [0.33, 0.67]	0.43 [0.33, 0.53]	0.48 [0.38, 0.56]	0.26 [0.15, 0.37]	0.24 [0.12, 0.35]
Voting makes me feel connected to others	0.56 [0.38, 0.70]	0.38 [0.27, 0.48]	0.42 [0.32, 0.52]	0.29 [0.18, 0.39]	0.21 [0.09, 0.32]
No one will care whether or not I vote	-0.35 [-0.53, -0.14]	-0.37 [-0.46, -0.26]	-0.43 [-0.53, -0.33]	-0.44 [-0.53, -0.34]	-0.24 [-0.35, -0.12]

Note. Intentions to register are only among those participants who had not already registered. PBC = perceived behavioral control.

Study 2: Message co-design and testing

Alternative text for messages included in the Message testing sample is included in Table S5. Alternative text for all messages included in the Message Development, Message Testing, and Study 3 experiment are available on OSF: https://osf.io/axrc7.

Table S5

Alternative text for each message tested in the Message testing sample

Message	Message text
duty_1	Frustrated with politics? Don't sit this one out. Vote to take responsibility for our future.
social_info_1	Voting is confusing! It's easier to make sense of it together. Share this step-by-step guide with people you care about! usa.gov/how-to-vote
social_info_2	Voting on campus is more fun with friends! Find the polls together. [Pictured: a text exchange reading: from the sender, "Hey! Do you know how to find our polling place?" From the receiver, "Yeah! Check out vote.upenn.edu/polling-places"]
self_1	Do you care about [abortion; climate change; free speech; war; inflation]? Voting is a way to express voice on an issue together.
self_2	The outcome of the election will impact these issues for better or for worse: abortion, war, climate change, inflation, free speech, healthcare. Vote to have a say in what happens.
self_3	Vote today, impact [abortion; climate change; free speech; war; inflation] tomorrow. Elections impact a lot in your daily life. You can fill the blank with anything!
self_4	People who care about [blank] should vote because it will have a major impact on [blank]. Elections impact a lot in your daily life. You can fill in the blanks with almost anything.
self_5	Don't be a passive bystander. Vote for the change you want to see in the world
self_6	Your vote, your voice, your change.
self_8	Did you know? Your vote affects... how the U.S. constitution gets interpreted, whether our country goes to war, local and state districting maps (who gets represented), and so much more. Vote!
efficacy_3	Panel 1: A graphic of one person saying, "My vote doesn't matter." Panel 2: A graphic of two people saying, "My vote doesn't matter." Panel 3: A graphic of a large group of people saying, "My vote doesn't matter." Panel 4: The whole United States saying, "My vote doesn't matter." Center text: "If your vote doesn't matter, no one's does. Every vote counts!"
efficacy_6	Myth: Voting doesn't matter if I'm not voting in a swing state. Fact: 33 states have Senate seats up for reelection and every state has Representative seats open--- *the ballot is more than a presidential election!*
social_6	Our vote, our voice, our change.
social_7	Voting makes you part of something bigger. A snowball gets bigger and faster with every snowflake. Your vote matters.

Message development sample ratings

Ratings for each message are reported in Table S6.

Table S6

Message effectiveness and nonpartisanship for each message tested in the Message development sample

Targeted belief cluster	Message	Nonpartisan rating *M* (*SD*)	Argument strength *M* (*SD*)	Belief strength *M* (*SD*)	Effectiveness score *M* (*SD*)
Belonging	social_1	3.91 (1.07)	3.54 (0.87)	5.28 (1.46)	19.67 (8.84)
	social_2	3.93 (1.13)	3.50 (0.87)	4.80 (1.69)	17.67 (8.58)
	social_3	4.02 (1.01)	3.45 (0.99)	5.13 (1.63)	18.87 (9.22)
	social_4	3.94 (1.19)	3.49 (0.99)	5.13 (1.61)	18.86 (9.03)
	social_5	4.07 (0.97)	3.49 (0.94)	5.35 (1.66)	19.68 (9.13)
Control	info_1	3.85 (1.11)	3.04 (0.86)	3.71 (1.66)	11.32 (5.98)
	info_2	3.71 (1.25)	3.20 (1.01)	3.46 (1.70)	10.77 (6.13)
	info_3	3.91 (1.11)	3.23 (1.01)	3.51 (1.98)	11.01 (7.13)
	info_4	4.07 (0.97)	3.31 (0.86)	3.88 (1.93)	12.51 (7.15)
	info_5	3.88 (1.02)	3.56 (0.88)	3.60 (1.77)	12.15 (6.14)
	info_6	4.12 (1.07)	3.63 (0.87)	2.72 (1.78)	9.33 (5.96)
Impact	self_2	3.41 (1.17)	4.10 (0.60)	5.78 (0.99)	24.11 (6.55)
	self_3	3.40 (1.17)	3.87 (0.82)	5.57 (1.46)	22.47 (8.74)
	self_8	3.75 (1.19)	3.89 (0.79)	5.35 (1.54)	21.79 (8.82)
Importance/negative	duty_1	3.89 (1.06)	3.20 (1.00)	4.78 (1.69)	16.44 (9.34)
	duty_2	3.97 (0.99)	3.76 (0.71)	5.55 (1.30)	21.47 (7.44)
	efficacy_1	3.70 (1.07)	3.06 (1.17)	4.81 (1.72)	15.54 (8.83)
	efficacy_2	3.03 (1.10)	3.68 (0.92)	5.19 (1.79)	19.82 (9.47)
	efficacy_3	3.94 (1.14)	3.81 (1.00)	5.61 (1.71)	22.11 (9.63)
	efficacy_6	3.75 (1.16)	3.69 (0.93)	5.21 (1.82)	20.06 (9.53)
Instrumentality	efficacy_4	3.83 (1.06)	3.52 (0.88)	5.13 (1.53)	18.61 (7.91)
	efficacy_5	3.81 (1.14)	3.59 (0.91)	5.31 (1.59)	19.76 (8.62)
	self_1	3.44 (1.29)	4.05 (0.62)	5.77 (1.29)	23.91 (7.76)
	self_4	3.94 (1.09)	3.69 (0.97)	5.30 (1.59)	20.73 (9.70)
	self_5	3.89 (1.10)	3.73 (0.96)	5.15 (1.69)	20.57 (9.21)
	self_6	4.19 (1.10)	3.74 (0.84)	5.21 (1.53)	20.33 (8.10)
	social_6	4.33 (0.82)	3.69 (0.82)	5.36 (1.34)	20.63 (8.16)
	social_7	3.98 (1.00)	3.91 (0.78)	5.87 (1.06)	23.46 (7.61)

Associations between promising belief metrics and message effectiveness

We conducted post-hoc analyses examining relationships between percentage to gain and belief centrality for the beliefs targeted in each message and message effectiveness. The primary and secondary beliefs targeted by each message are listed for each message on OSF: https://osf.io/axrc7. We combined data from the Message development and testing samples and averaged centrality and percentage to gain across all beliefs targeted in each message to get a single value for each, per message. We then fit linear mixed effects models regressing each measure of message effectiveness (composite effectiveness score, argument strength, and belief strength) on all potential models including the fixed effects of centrality and percentage to gain (i.e., main effects of each separately, main effects of both, and the interaction between them), as well as intercept only models. In each model, intercepts were

allowed to vary randomly across participants and messages. We used the Akaike Information Criterion (AIC) to compare models and treated a decrease in AIC of at least 2 points to be considered a better fitting model. When two models had less than a 2-point difference, we interpret the more expansive model. Model comparisons are reported in Table S7 and results from the best fitting models are reported in Table S8. For illustrative purposes, model fitted predictions from the models that include the main effects of both percentage to gain and belief centrality are visualized in Figure S2.

The best fitting models either only included belief centrality or the main effects of both centrality and percentage to gain. In all models, belief centrality was the strongest predictor of message effectiveness. The best fitting model for argument strength did not include percentage to gain and this measure was not associated with argument strength (Figure S2).

Table S7

Model comparisons

Outcome	Model	*df*	*AIC*
Effectiveness score	**Centrality**	**5**	**8152.96**
	Centrality + Percentage to gain	**6**	**8153.77**
	Centrality * Percentage to gain	7	8158.12
	Intercept only	4	8169.39
	Percentage to gain	5	8171.80
Argument strength	**Centrality**	**5**	**8239.76**
	Centrality + Percentage to gain	6	8245.34
	Intercept only	4	8245.73
	Percentage to gain	5	8247.14
	Centrality * Percentage to gain	7	8250.56
Belief strength	**Centrality + Percentage to gain**	**6**	**8593.31**
	Centrality	**5**	**8594.82**
	Centrality * Percentage to gain	7	8597.43
	Intercept only	4	8606.84
	Percentage to gain	5	8610.60

Note. The best fitting model(s) are bolded.

Table S8

Results from the best fitting models

Outcome	Marginal R^2 / Conditional R^2	*N* (*df*)	Variable	β	95% CI	*t*	*p*
Effectiveness score	0.10 / 0.48	315 (41.06)	Intercept	-0.04	-0.18 - 0.11	0.51	.611
	0.10 / 0.48	315 (28.05)	Centrality	0.44	0.28 - 0.59	5.87	< .001
	0.10 / 0.48	315 (26.81)	Percent gain	0.17	0.01 - 0.34	2.14	.042
Argument strength	0.03 / 0.44	315 (56.96)	Intercept	-0.04	-0.16 - 0.08	0.66	.511
	0.03 / 0.44	315 (29.76)	Centrality	0.17	0.08 - 0.26	3.82	< .001
Belief strength	0.09 / 0.38	315 (33.24)	Intercept	-0.02	-0.17 - 0.12	0.32	.748
	0.09 / 0.38	315 (27.29)	Centrality	0.45	0.29 - 0.61	5.72	< .001
	0.09 / 0.38	315 (26.07)	Percent gain	0.23	0.05 - 0.41	2.68	.013

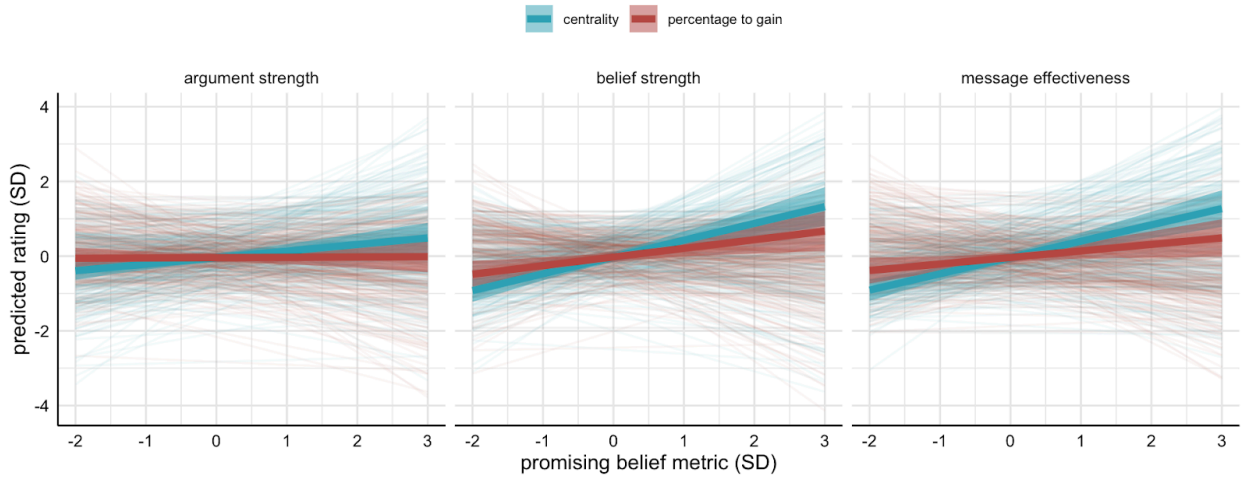

Figure S2. Associations between promising belief metrics (percentage to gain and centrality) and message effectiveness ratings (argument strength, belief strength, message effectiveness). The thick lines are the estimated slopes from the linear mixed effects models, whereas the thin lines are the slopes for each participant estimated from the raw data. Error bands are 95% confidence intervals.

Study 3: Message experiment

Descriptives for all message-level variables

In addition to the primary outcomes reported in the main manuscript, participants rated several secondary outcome measures using the same sliding scale (0 = strongly disagree, 100 = strongly agree): social relevance ("This message is relevant to people I know"), willingness to broadcast ("I would share this message by posting on social media"), willingness to narrowcast ("I would share this message directly with someone I know"), positive emotions ("This message makes me feel hopeful, optimistic, or inspired"), negative emotions ("This message makes me feel fearful, anxious, or worried"), message nonpartisanship ("This message is nonpartisan"), and aesthetics ("This message is visually appealing"). Descriptive statistics for each message type are reported in Table S9 and correlations among variables are reported in Table S10.

Table S9

Mean and SD for each message rating, per message source.

Variable	co-designed messages N = 1,587	control messages N = 1,586	student control messages N = 350
Aesthetics	55.23 (28.59)	49.47 (31.95)	54.57 (31.07)
Nonpartisanship	55.85 (34.03)	59.14 (36.30)	72.37 (30.62)
Motivation to vote	60.21 (29.81)	45.60 (31.30)	49.39 (29.72)
Persuasiveness	60.24 (28.47)	43.58 (30.20)	46.78 (30.07)
Self-relevance	60.65 (29.88)	54.03 (31.76)	62.75 (29.28)
Social relevance	63.88 (28.61)	56.88 (30.53)	67.42 (27.12)
Broadcast sharing intention	39.01 (33.98)	35.46 (33.25)	35.60 (33.10)
Narrowcast sharing intention	37.70 (33.18)	34.11 (32.70)	40.07 (35.04)
Negative emotions	32.65 (28.34)	21.25 (24.90)	21.79 (23.10)
Positive emotions	47.01 (30.28)	40.36 (30.15)	42.44 (29.76)

Note. Ratings are on a 0-100 scale.

Table S10

Correlations among message-level variables (across samples and message sources)

	Variable	1	2	3	4	5	6	7	8	9
1	Aesthetic									
2	Nonpartisan	.19** [.16, .22]								
3	Motivation to vote	.60** [.58, .62]	.13** [.10, .16]							
4	Persuasiveness	.62** [.60, .64]	.18** [.15, .21]	.75** [.74, .76]						
5	Self-relevance	.48** [.46, .51]	.21** [.18, .24]	.66** [.64, .68]	.56** [.54, .58]					
6	Social relevance	.48** [.45, .50]	.22** [.19, .25]	.63** [.61, .65]	.55** [.53, .57]	.83** [.82, .84]				
7	Broadcast sharing intention	.50** [.47, .52]	.11** [.08, .15]	.59** [.57, .61]	.50** [.48, .53]	.50** [.48, .53]	.47** [.44, .50]			
8	Narrowcast sharing intention	.48** [.45, .50]	.08** [.05, .12]	.57** [.54, .59]	.48** [.45, .50]	.49** [.46, .51]	.49** [.47, .52]	.79** [.77, .80]		
9	Negative emotion	.09** [.05, .12]	-0.03 [-.06, .01]	.22** [.19, .25]	.22** [.19, .25]	.14** [.11, .17]	.13** [.10, .17]	.12** [.09, .15]	.12** [.09, .15]	
10	Positive emotion	.59** [.56, .61]	.10** [.07, .13]	.71** [.70, .73]	.63** [.61, .65]	.52** [.49, .54]	.51** [.49, .54]	.59** [.57, .61]	.58** [.56, .60]	.10** [.07, .14]

Note. Values in square brackets indicate the 95% confidence interval. * indicates $p < .05$. ** indicates $p < .01$.

Secondary analyses: Message sharing and affective responses to messages

In preregistered secondary analyses, we investigated the effect of message source (co-designed vs. control) on message sharing and affect. Models were fit using the same approach described in the main manuscript. We expected that participants would have higher intentions to broadcast—share widely such as on social media—and narrowcast—share with specific individuals—the co-designed messages compared to the control messages. In line with this hypothesis, we found that the co-designed messages elicited slightly stronger broad- and narrowcast sharing intentions than control messages (Table S11). With respect to affective ratings, we expected that the co-designed messages would evoke more positive emotion than the control messages. We did not preregister a hypothesis about negative emotion, but include this as an exploratory outcome. We found that co-designed messages evoked both more positive and negative emotions than control messages (Table S11).

Table S11

Results from models testing message effects on secondary outcomes measures

DV	Marginal R2 / Conditional R2	N (df)	Variable	b	95% CI	t	p
Broadcast sharing	0.00 / 0.66	321 (351.71)	Intercept	35.21	32.04 - 38.38	21.86	< .001
		321 (2795.30)	Source (co-designed)	3.45	2.07 - 4.83	4.89	< .001
Narrowcast sharing	0.00 / 0.64	317 (351.06)	Intercept	34.20	31.13 - 37.27	21.90	< .001
		317 (2791.05)	Source (co-designed)	3.53	2.12 - 4.94	4.92	< .001
Positive emotion	0.01 / 0.48	320 (385.15)	Intercept	40.29	37.75 - 42.84	31.16	< .001
		320 (2804.02)	Source (co-designed)	6.61	5.07 - 8.15	8.43	< .001
Negative emotion	0.04 / 0.42	320 (412.18)	Intercept	21.26	19.14 - 23.38	19.71	< .001
		320 (2790.15)	Source (co-designed)	11.43	9.97 - 12.89	15.35	< .001

Sensitivity analyses: Controlling for aesthetic quality and nonpartisanship

We conducted sensitivity analyses including aesthetic quality and nonpartisan ratings in the primary models reported in the main manuscript. Controlling for these variables reduced the magnitude of the message source effects, but all remain statistically significant (Table S12).

Table S12

Results from models including aesthetic quality and nonpartisanship

DV	Marginal R2 / Conditional R2	N (df)	Variable	*b*	95% CI	*t*	*p*
Motivation to vote	0.30 / 0.54	319 (1153.78)	Intercept	20.18	17.37 - 22.99	14.10	< .001
		319 (2802.82)	Source (co-designed)	11.99	10.55 - 13.42	16.34	< .001
		319 (3108.32)	Aesthetic	0.47	0.44 - 0.50	32.21	< .001
		319 (2593.79)	Nonpartisan	0.04	0.01 - 0.07	2.29	.022
Persuasiveness	0.38 / 0.51	319 (1212.56)	Intercept	14.44	11.94 - 16.94	11.33	< .001
		319 (2802.88)	Source (co-designed)	13.96	12.51 - 15.41	18.89	< .001
		319 (3050.27)	Aesthetic	0.51	0.48 - 0.54	35.51	< .001
		319 (1836.03)	Nonpartisan	0.07	0.04 - 0.10	4.76	< .001
Self-relevance	0.16 / 0.53	319 (1035.62)	Intercept	31.71	28.62 - 34.80	20.12	< .001
		319 (2811.74)	Source (co-designed)	5.00	3.56 - 6.45	6.78	< .001
		319 (3073.68)	Aesthetic	0.35	0.32 - 0.38	23.31	< .001
		319 (2936.79)	Nonpartisan	0.09	0.06 - 0.12	5.41	< .001

Exploratory analyses: Message-level effects

This exploratory analysis aimed to identify which messages were most effective overall. We fit a linear mixed effects model regressing each outcome separately on the fixed effect of message; intercepts were allowed to vary randomly across participants. Figure S3 shows the marginal effects for each message. All co-designed messages were rated as motivating, persuasive, and self-relevant (i.e., means are >50, the scale midpoint), whereas control messages tended to be rated as not motivating and not persuasive. Overall, the co-designed messages tended to be the most motivating and persuasive, but results were more mixed for self-relevance. The most motivating and persuasive message targeted the belief that an individual's vote doesn't matter.

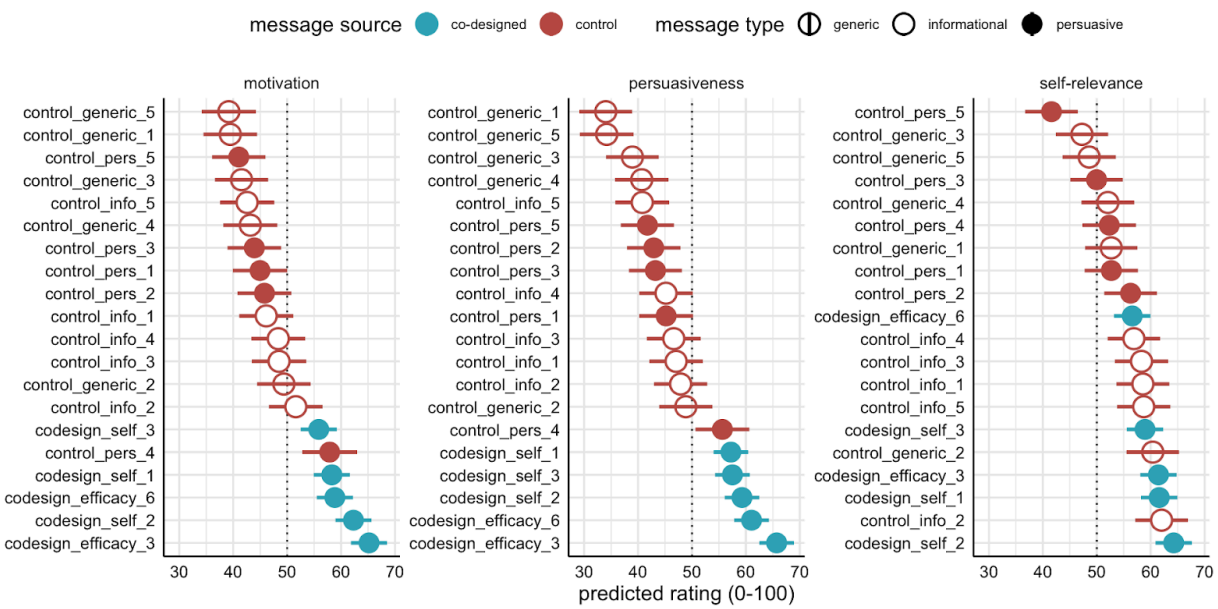

Figure S3. Mean estimates of motivation to vote, persuasiveness, and self-relevance from linear mixed effects models for each message separately. Error bars are 95% confidence intervals.

Preregistered secondary analyses: Student control messages

In the Local sample, we also tested a set of secondary control messages that were obtained from an internal repository of prior social media posts from Penn Leads the Vote, a student-led GOTV organization at our institution. The purpose of including these messages was to compare the effectiveness of our messages that were co-designed with youth *and* targeted promising beliefs, relative to messages that were designed by youth but without evidence-based belief targeting. These secondary control messages were evaluated for inclusion based on the same criteria as our primary control messages from Rock the Vote. This resulted in 10 secondary control messages, including 5 generic messages, 3 informational messages, and 2 persuasive messages. In addition to the co-designed and Rock the Vote control messages, participants in the Local sample saw an additional random sample of 5 out of 10 secondary control messages.

We expected that the student control messages would be more self-relevant since they are tailored to the Local sample, and thus predicted that the co-designed messages would be more motivating and persuasive than the student control message and at least as self-relevant. In line with these preregistered hypotheses, we found that compared to the student control messages across message types, the co-designed messages were more motivating and persuasive, and were similarly self-relevant (Table S13; Figure S4). As expected, we also found that the co-designed messages were more motivating and persuasive than all message types. However, in contrast to our predictions, the co-designed messages were rated as less self-relevant than persuasive and informational messages, and similarly self-relevant as generic messages.

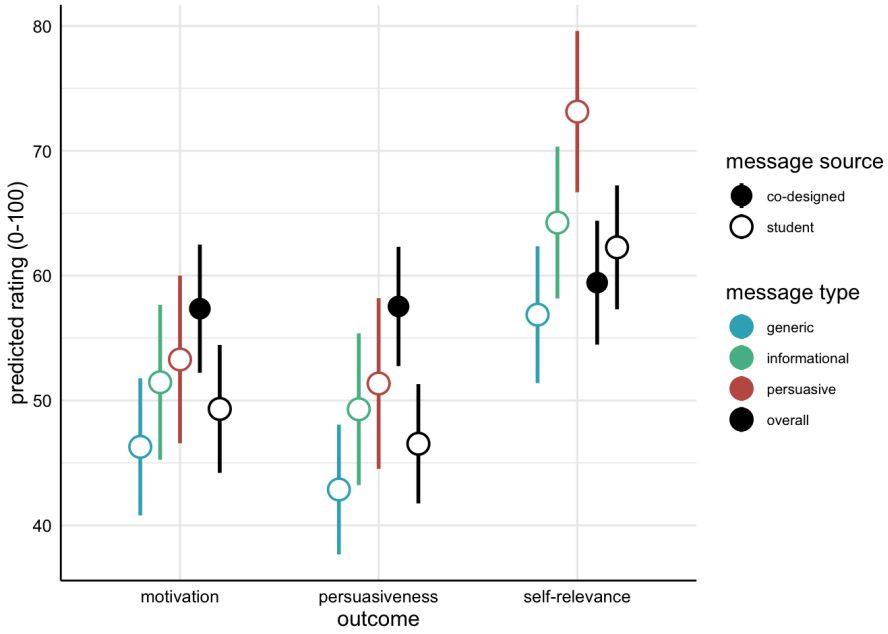

Figure S4. Mean estimates from linear mixed effects models for message motivation to vote, persuasiveness, and self-relevance in the Local sample using student-generated control messages. (A) Message effects as a function of message source (co-designed or student) and message type. Black points and error bars show effects from models collapsed across message types. Colored points and error bars are from models comparing the co-designed messages to each control message type (generic, informational, persuasive).

Table S13

Model summary for primary hypothesis tests with the student-generated control messages in the Local sample

DV	Message type	Marginal R^2 / Conditional R^2	*N* (*df*)	Variable	*b*	95% CI	*t*	*p*
Motivation to vote	Overall	0.02 / 0.48	71 (85.04)	Intercept	49.32	44.14 - 54.51	18.90	< .001
			71 (613.36)	Source (co-designed)	8.03	4.87 - 11.18	5.00	< .001
	Generic	0.03 / 0.48	71 (114.46)	Intercept	46.29	40.75 - 51.82	16.56	< .001
			71 (441.61)	Source (co-designed)	11.08	7.18 - 14.98	5.58	< .001
	Informational	0.01 / 0.54	70 (133.27)	Intercept	51.46	45.21 - 57.71	16.29	< .001
			70 (379.77)	Source (co-designed)	5.65	1.29 - 10.01	2.55	.011
	Persuasive	0.00 / 0.53	70 (179.70)	Intercept	53.29	46.54 - 60.03	15.59	< .001
			70 (343.59)	Source (co-designed)	3.84	-1.31 - 8.98	1.47	.143
Persuasiveness	Overall	0.03 / 0.38	70 (91.26)	Intercept	46.53	41.70 - 51.37	19.12	< .001
			70 (618.07)	Source (co-designed)	11.00	7.51 - 14.49	6.19	< .001
	Generic	0.06 / 0.37	70 (139.60)	Intercept	42.87	37.64 - 48.10	16.20	< .001
			70 (445.90)	Source (co-designed)	14.70	10.40 - 19.00	6.72	< .001
	Informational	0.01 / 0.39	70 (176.24)	Intercept	49.30	43.19 - 55.40	15.93	< .001
			70 (389.36)	Source (co-designed)	8.19	3.17 - 13.21	3.21	.001
	Persuasive	0.01 / 0.36	70 (256.75)	Intercept	51.36	44.51 - 58.21	14.76	< .001
			70 (352.39)	Source (co-designed)	6.15	0.10 - 12.21	2.00	.046
Self-relevance	Overall	0.00 / 0.45	72 (87.88)	Intercept	62.27	57.25 - 67.29	24.64	< .001
			72 (622.49)	Source (co-designed)	-2.83	-5.99 - 0.33	1.76	.080

Generic	0.00 / 0.49	72 (113.02)	Intercept	56.88	51.35 - 62.40	20.39	< .001
		72 (448.74)	Source (co-designed)	2.60	-1.15 - 6.34	1.36	.173
Informational	0.00 / 0.46	71 (155.14)	Intercept	64.26	58.14 - 70.37	20.76	< .001
		71 (388.10)	Source (co-designed)	-4.71	-9.35 - -0.06	1.99	.047
Persuasive	0.03 / 0.51	71 (194.17)	Intercept	73.14	66.66 - 79.63	22.26	< .001
		71 (351.01)	Source (co-designed)	-13.63	-18.72 - -8.54	5.27	< .001

We also conducted analyses examining our secondary outcomes of interest. As in the primary analyses, the co-designed messages evoked more negative emotion than the control messages (Table S14). In contrast to the primary analyses, participants reported lower narrowcast sharing intentions for the co-designed compared to the student control messages. Co-designed and student control messages elicited similar broadcast sharing intentions and positive emotions.

Table S14

Results from models testing message effects on secondary outcomes measures with the student-generated control messages in the Local sample

DV	Marginal R2 / Conditional R2	*N* (*df*)	Variable	*b*	95% CI	*t*	*p*
Broadcast sharing	0.00 / 0.72	71 (75.66)	Intercept	34.39	27.52 - 41.26	9.97	< .001
		71 (593.86)	Source (co-designed)	-2.26	-4.91 - 0.39	1.67	.095
Narrowcast sharing	0.01 / 0.63	69 (76.19)	Intercept	39.86	33.08 - 46.64	11.71	< .001
		69 (598.15)	Source (co-designed)	-6.01	-9.13 - -2.89	3.78	< .001
Positive emotion	0.00 / 0.51	71 (83.06)	Intercept	42.09	36.69 - 47.50	15.48	< .001
		71 (604.07)	Source (co-designed)	0.53	-2.55 - 3.61	0.34	.735
Negative emotion	0.08 / 0.44	70 (90.78)	Intercept	21.15	16.86 - 25.44	9.8	< .001
		70 (584.82)	Source (co-designed)	14.31	11.33 - 17.29	9.43	< .001