PAPER

Narrative influence on support of a public policy: the case of nuclear power in the Netherlands

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Abstract

We propose a new methodology to systematically transform pre-surveyed argument preferences into fictional narratives, that can help people to imagine the consequences of future events, and measure how they impact willingness to pay for a public policy. We apply narrative theory to construct two short narratives that depict an imaginary future, bleak due to climate change or energy dependence, and show experimentally that exposure to these narratives increases contributions in a Public Goods game, framed as payments towards the construction of new nuclear plant in the Netherlands. Our results suggest that fictional narratives can be used (and misused) as a tool of economic policy that allows conveying relevant information to people about complex issues. We discuss the ethical use of narratives and the value of their transparent construction for democratic will-formation and policy implementation when abstract factual information can be difficult to process or comprehend.

Key words: narratives, cooperation, future studies, public goods, economic policy, technology ethics.

Introduction

Complex societal issues such as global warming, pandemics, or demographic change pose the challenge for democracies to make and implement knowledge-based decisions. Simply providing more information to the population does not automatically enhance the depth of discourse or increase the acceptance of unpopular decisions. Similarly, the idea that people just lack information disguises the often-underlying value conflicts or ambiguous perspectives and can generally be considered outdated [37]. People do not "assimilate, or experience science different from other elements of knowledge or judgment" (ibid.) and facts only matter within the frames and contexts that structure a policy discourse. That is why large parts of political communication are mainly about setting frames that stage evidence, action, and authority in favor of preferred positions.

The call for new narratives to address the aforementioned challenges is omnipresent and at the same time difficult to tackle. To explain the meaning of narratives in public discourse, Roland Barth [2] suggested the homology that sentences become meaningful within a narrative, just as

words make sense within a sentence. Understanding a policy discourse as the third level of meaning, therefore, reveals how dominant narratives give relevance to uttered sentences suggesting different pathways for action. To this end, it has been shown that varying narratives can change what facts, data, values, and research proposals are considered relevant in the assessment of a future technology in mass-media discourse [29, 11, 27] and at the level of group interaction [25]. Thus, the purposeful construction of narratives could help mitigate conflicts and help people take a different perspective.

Narratives are considered useful in situations when some limits on understanding involved arguments and/or on attention create constraints for engagement in argumentative communication. Studies under the "homo narrans" paradigm suggest that narrative understanding is more efficient and "natural" and that narratives constitute a socio-cultural prerequisite for being part of a community [18, 8, 31]. Instead of reasoning about the evidence or consistency of arguments for or against policy options, narratives "simulate" the experience of how such facts might unfold within a context of action [21, 10]. Given that processing factual information often requires skills
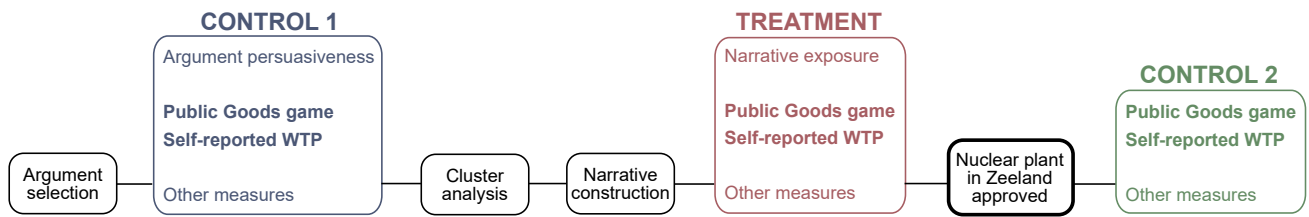
Fig. 1. Timeline of the experiment from left to right and the point in time when the nuclear plant in Zeeland was approved by Dutch government.

and background knowledge that only a small part of the population shares, the purposeful use of narratives can help to include people in political debates and give relevance to neglected positions. However, using narratives in democratic will-formation or policy implementation demands an ethical assessment for each case, as we argue in Section "The ethical use of narratives in democratic will-formation and policy implementation."

The study of new narratives that can enhance policy communication has been difficult because of the ambiguous meaning of the term "narrative" within different disciplines and discourses. In some literatures, narrative refers to a structure inherent in political or life-course discourses across different sites, media, and occasions that explains emergent conflicts and coalitions or reorientation. At the same time, social science approaches, such as the narrative policy framework [29, 6] or the narrative discourse analysis [33], compare frames or topics by word co-occurrence and study narrative structures that represent factual actors as heroes, villains, or helpers whose actions and success or failure suggests a moral or policy preference.[1] The study of narratives by literary scholars does not exclude these approaches but, in contrast, tends to examine linguistic features and the cultural perception of specific text sections of books or defined corpora with more qualitative detail due to a different research interest (for an overview see [28]). In our eyes, these research traditions do not exclude but complement each other and provide valuable distinctions for our narrative design in Section "Narrative construction."

In this study, we test experimentally whether narratives can significantly impact currently relevant economic decision-making and policy. Specifically, we propose a method to systematically transform the pre-surveyed relevance and preferences for technology features in a population into *fictional narratives* (in our case two: 362 and 288 words) that significantly increase their willingness to pay by highlighting and downplaying focused aspects of the public discourse. Notice that our aim is to check how people's economic choices change in response to a narrative, but we do not consider whether text characteristics influence the oral and medial dissemination that precedes the narrative exposition. To test whether our narratives were successful at convincing people, we compared the contributions in a Public Goods game [14] between subjects who were exposed to a narrative and a control group [22, 12]. We found that both narratives significantly increased the contributions by 18%, thus validating our hypothesis and methodology.

To conduct the study in a realistic policy context, we constructed two narratives related to the currently active discussion of the future of nuclear energy in the Netherlands. The most recent evaluation of public support in the Netherlands found that only 45% of Dutch citizens would want more nuclear generated energy [13]. Conversely, multiple independent research teams have determined that increasing the nuclear power capacity in the Netherlands would be a welfare-enhancing policy [32, 36]. The growth of nuclear power capacity in the Netherlands is contingent on public approval, given that government subsidies and guarantees are fundamental in securing the necessary finances for new nuclear power plants [32]. This setting therefore provides a good testing ground for our methodology. The consequences of planning more nuclear plants are complex and highly uncertain. Thus, it is reasonable to believe that some people might be overwhelmed or confused about this debate and that narratives can help them to make sense of some central issues at stake when people decide on the future of nuclear energy.[2]

Methods

The experiment was approved through the agreement between BEELab (Maastricht University) and the Ethical Review Committee Inner City Faculties (Maastricht University). No number was issued given the agreement to approve standard economics experiments. Written consent was not directly obtained from participants since the participants were registered survey takers on Prolific.co and they gave consent to participate in surveys when they registered there.

The experiment was conducted in Dutch using the combination of a Qualtrics survey and subjects recruited at Prolific. Overall, there were 450 participants, of whom 405 were unique (45 subjects participated in two experimental sessions). Participants were recruited with one participation condition: Dutch as a first language. No pilot experiments were run or participants discarded. For demographic information across treatments see Supplementary material S10.

Figure 1 shows the timeline of the experiment from left to right. Supplementary material S7 contains all instructions (for Dutch version see S8). In the first step, we selected arguments related to nuclear energy that were collected from the most popular mass media [19] with the idea to use the most persuasive arguments in the narrative construction. We analyzed articles on nuclear power published by major Dutch news broadcasters as well as those produced by Google searches on "Arguments against nuclear power" and "Arguments in favor

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[1] Both deductively exploiting Vladimir Propp's morphology of the folk tale [24]. For theoretical models of language and preferences within economics and psychology see also the review [4].

[2] It is worth noting that we, as academics, refrain from assessing the usefulness of new nuclear power plants and are primarily interested in the possible role of fictional narratives in a very technical and yet identity-political discourse.
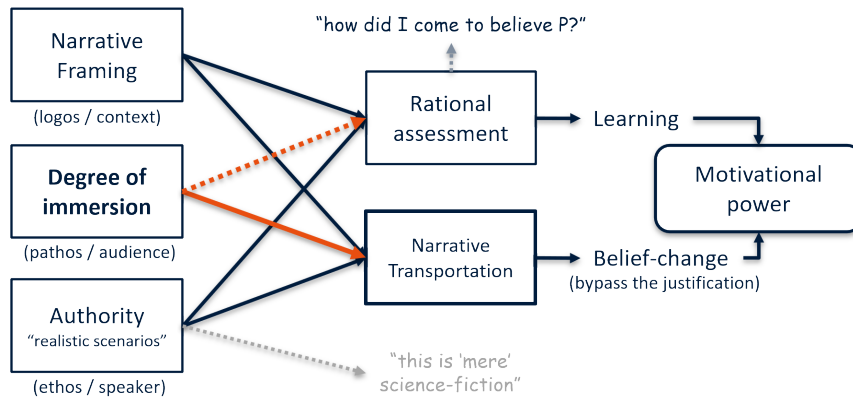
Fig. 2. Three rhetorical dimensions of our study that guide deliberation or manipulation of narratives.

of nuclear power." We collected all proposed arguments from these articles, grouped them thematically to lower the number of arguments, and formulated core messages of each thematic group. Twelve final arguments resulted from this analysis (see survey questions in Supplementary material S7.1).

We used the twelve resulting arguments to evaluate their persuasiveness in Control 1, the first experiment with 150 subjects, who were given the Argument Persuasiveness questionnaire for that purpose (see Supplementary material S7.1). In Control 1, we also elicited subjects' *contributions in the Public Goods game* (incentivized with real money and framed as paying taxes for building a new nuclear plant that leads to lower electricity prices for everyone; see Supplementary material S7.2) and unincentivized *self-reported willingness to pay for nuclear energy* (Self-reported WTP or SWTP; see Supplementary material S7.3). We use both measures to test the effects of narrative exposure. Notice that subjects in Control 1 chose in the Public Goods game and reported their WTP without being exposed to any narratives. We use the choices in Control 1 as a benchmark to compare with subjects who were exposed to narratives in another treatment.

In the next step, we used the Argument Persuasiveness questionnaire from Control 1 to construct narratives. First, we conducted cluster analysis and found two clusters of subjects different in terms of the persuasiveness of the twelve arguments about nuclear power. Then, for each group we chose the most persuasive arguments (though, see Supplementary material S1.3 for details) and constructed two narratives that take into account the arguments chosen for each cluster.

In Treatment, we exposed 75 subjects to each narrative (150 subjects overall: 105 new subjects and 45 repeated from Control 1, see also Section "Additional checks" for more details) and then elicited their contributions in the Public Goods game and their self-reported willingness to pay (along with other measures). These choices of participants in Treatment are our main variables of interest that we compare to the same choices in control treatments, where participants were not exposed to narratives. This comparison allows us to verify the effects of our constructed narratives on policy relevant behavior.

After Treatment, we also ran Control 2 (150 new subjects), which was the same as Control 1 but without the Argument Persuasiveness questionnaire. The goal of Control 2 was to make sure that any effect we observe between Control 1 and Treatment is not the result of some (unknown) trend in people's opinions or change in their preferences that could have resulted

from some event that took place between measurements. We, thus, aim to detect the effect of narrative exposure by comparing the contributions in the Public Goods game and SWTP between Treatment and the two controls.[3]

Finally, a major unexpected event related to nuclear energy in the Netherlands did in fact take place between Treatment and Control 2. The Dutch government—after a long public debate and years of planning—has approved the construction of nuclear power plants in Zeeland. This presented us with a perfect robustness check to test if this event had an effect on the contributions and views expressed by our subjects.

Narrative construction

This section outlines our method to translate arguments with persuasive intent into narrative form. We understand a narrative as a representation of a sequence of events (story) held together by the plot [1]. Engaging with a narrative means to imagine what is according to the text (explicitly and implicitly) is to be imagined [34, 25].[4] A text thus *calibrates* what the audience imagines and allows a group to jointly explore, experience, and discuss fictional worlds from the inside instead of only assessing the language or truth value of claims.

Crafting a (technology) narrative is an iterative process on the level of the story (i.e. how emphasized technology features become crucial for the fictional course of action) and discourse (what words, voices, and other means suit to best tell this story for the audience). The process is iterative as characters and the setting define the story world and potential actions or events in the plot as well as provide the voice, authority, and sympathy for the author to speak to an audience. Iteration is also important to refine what information to make explicit, e.g. about the protagonist or the setting, and what gaps are to be filled by the audience. The general implicit rule for engaging

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[3] The fact that Control 1 contained Argument Persuasiveness questionnaire, while Control 2 did not, does not present a problem for our analysis since the choices in Control 1 and Control 2 are virtually indistinguishable (see discussion below).

[4] In terms of Gérard Genette's narrative triangle [9], narratologists distinguish the guided imagination practice as "narrative situation" from the set of instructions as "narrative discourse," and situate the fictional setting, imagined characters, and their actions or concerning events in the "story world."
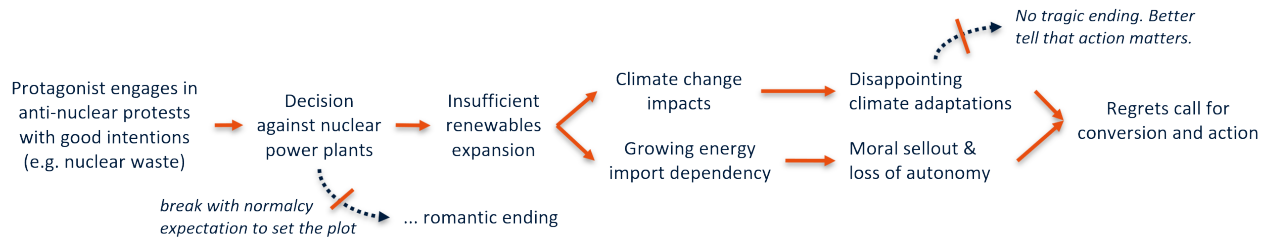
Fig. 3. The two stories outline causal sequences of events. The stories end with a moral or policy implication but due to different arguments as represented in the plot.

with narratives is to understand everything stated explicitly as being relevant for the overall plot and its consequent moral or policy implications. As outlined in Figure 2, we aim to control three dimensions for persuasive narrative design on the basis of Aristotle's rhetorical triangle, namely the plot and framing (logos), immersion (pathos), and authority (ethos).

Central to a persuasive narrative is deciding what the plot is about, or respectively what arguments or concepts to focus on. In contrast to a defense speech or scientific debate, the narrative carries the argument and moral implication by the logic of represented sequential events. One event follows the other and, within the limitations of a coherent plot, the narrators decides what to focus on and what to keep out of the frame. A popular way for plot construction is representing certain key events or actions as a deviation from a stated normalcy that calls for a resolution. To do so, the text engages the audience's ideas about routines, social relationships, or relationships with technology, portrays them as what is normal, and incites imagining a deviation with meaningful consequences - e.g., someone foreign arrives or leaves town or the discovery of new technology leads to tensions in established routines and require further investigation. Closure then restores the old or suggests a new normalcy to resolve this emergent tension in the course of the story, but closure is no necessity. Still, in order to draft a narrative *about* nuclear power, features of nuclear power must not only be part of the setting or in a relationship to characters but they must be relevant for the plot.[5]

Persuasion and behavioural change do not require explicit claims about reality to simulate experiences about real-world settings. Still, readers must employ beliefs to their imagination to draw inferences that affect long-term behavior [26]. If values, such as political independence or corporate profits, do not matter to the reader, but are thought to influence attitudes to technology, the narrative must additionally depict this, e.g, by representing consequences of their ignorance being undesirable. For our case study, we transformed the two clustered argument preferences into causal sequences of events. We use flashbacks to the real "anti-nuclear movement," the slow expansion of renewable energy in Europe, and the Netherlands's beautiful landscape as "indices" [2] that "root" [20] the audience's imagination (see Figure 3). We follow [10, 6] in measuring

the congruence of the depicted world and participants previous knowledge and attitudes in two congruence factors.

We interpret a story's emotional appeal (pathos) as the archieved depth of immersion and compliance with the story and framing. The general idea of narrative transportation and immersion is to simulate experiences in a fictional world that change the appreciator's understanding of the real world. Steering the degree of immersion first and foremost depends on the text style and plot quality [10]. The conscious handling of information provided by the text as the plot develops (focalization) creates suspense and surprise as the driving force for the imaginative engagement anticipating the course of action. Because style is a complex concept, we mainly focus on catalysts, relatable characters, and "immersive resistance". Catalysts are words and descriptions that do not carry the events as the plot-nuclei do but guide attention, stretch the time engaging with certain events, and catalyze the mood and feeling [2]. Relatable characters meet the audience and discourse, allowing to take perspective when they fear, fume, or suffer. Finally, the text must avoid "immersive resistance" due to general situations or events that readers just want to avoid imagining, such as rape or torture. In the end, however, good style can encompass a variety of text features and, in our functional understanding, complements the plot for the coherent experience of a narrative world. In our stories, the insufficient expansion of renewable energy breaks with the established normalcy expectation of not wanting nuclear power plants, which allows to represent counter-arguments and implies consequences the protagonist has to face: climate change and dependence on energy imports. Stylistic features, such as catalysts are highlighted in the annex.

We interpret ethos—which in classical rhetoric means representing the speaker as a trustworthy, virtuous, or social community member—as the authority and credibility given to the story so that it is not perceived as "mere science-fiction".[6] To generate "fictions of authority" [17], we use the voice and domain-specific authority of relatable stereotype characters that explain how the world works from their first-hand experience. Our protagonists are a teacher who knows and cares about the decline of values and a gardener who knows

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[5] Likewise, there is an implicit convention in appreciating narratives to expect that any explicit detail matters for the overall plot or discourse that the story is considered to be part of [2]. If you would, for example, make the protagonist a safety officer in a nuclear power plant or an opponent of nuclear power, the audience is encouraged to assume that this position or related stereotypes make a difference in the course of the story.

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[6] Understanding science fiction as unpolitical or irrelevant for technology development would be an understatement of the genre, as, e.g. studies in vision assessment show [27]. While science fiction often plays in distant futures or universes, good plots and interesting protagonists resonate with the problems, desires, and attitudes of their audience. Indices to existing scientific claims and technology, as typical for the genre, then suggest engaging with regarding beliefs about reality as being relevant to these matters.
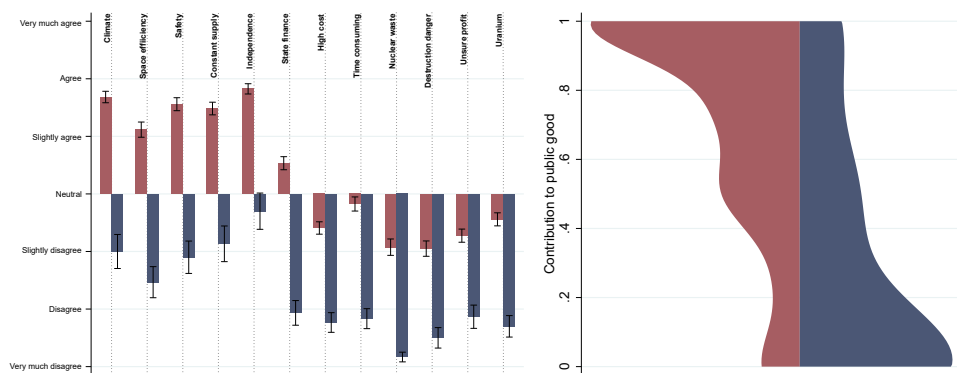
Fig. 4. Left Panel. Average answers to Argument Persuasiveness questions in the two clusters of subjects from Control 1. Error bars stand for standard errors. See Supplementary material S7.1 for the descriptions of the questions. **Right Panel.** Distributions of contributions to public good in the two clusters.

and cares about environmental devastation. Alternatives to claim authority can be scientists, "white old men", "Silicon Valley visionaries", or side stories and flashbacks in which actors have demonstrated virtues and good intentions through their actions. Other sources of authority that indicate a knowledgeable narrator and activate beliefs about reality are references to official documents, scientific references, or folk histories about the success of earlier disruptive technologies. In addition, studies in advertisement showed that perceived manipulative intention—as within one-sided instead of two-sided augmentations to communicate honesty and deny manipulative intentions—hinder persuasion [23, 5]. Despite this, truth as personal relevance and truth as stylistic and logical coherence within complex textual structures can be sufficient to claim authority for the narrative transportation pathways [21].

Argument selection and clustering

To determine the arguments about nuclear energy that should be used in the story, we analyze Argument Persuasiveness questions asked in Control 1 (based on [38], but see also [35] for similar approach). We evaluate whether the statements related to 12 arguments in the discussion around nuclear energy in the Netherlands (see Supplementary material S7.1) increase subjects' willingness to pay, together with others, for it. An agreement to pay more, given an argument, signals that the subject considers the argument as positive and can be persuaded by it. Similarly, disagreement signals that the subject takes the argument as a negative and will not be persuaded.

The left panel of Figure 4 shows the average answers to Argument Persuasiveness questions in the two clusters of subjects in Control 1. The clusters were determined by the answers to the 12 questions and the analysis summarized in Supplementary material S2. Notice that the averages are strikingly different in the two clusters. While in the red cluster (120 subjects), subjects have positive view on the first six arguments and somewhat negative on the last six, in the blue cluster (30 subjects) the average answers are rather negative almost everywhere. This presents the case of a minority (20%) that sees nuclear energy as not a very reasonable solution, a minority that does not share the majority's views that nuclear energy is a viable solution due to at least first six arguments. This disagreement on nuclear energy issues also manifests itself

in the contributions to public good. The right panel of Figure 4 shows the Gaussian-smoothed distributions of contributions in the two clusters. Most subjects in the majority red cluster contribute full amounts (average contribution 73%), whereas in the minority blue cluster most subjects contribute zero (average contribution 29%). The difference between the distributions is significant (rank-sum test: $p < 0.0001$).

Given such a large disagreement between subjects in the two clusters, we decided to create two versions of the narrative structure designed to address the most persuasive arguments of each group. We chose argument Climate (*"More nuclear power will help us to meet the climate goals"*) for subjects in the red cluster and argument Independence (*"More nuclear power plants increase our independence from other nations for our energy needs"*) for subjects in the blue cluster as the most persuasive, main arguments. For each narrative, we chose three additional arguments out of which there was at least one positive and one negative. Supplementary material S7.3 details which phrases in the narratives correspond to which arguments. Notice that the choice of arguments for narratives does not have to follow the schema that we used. We chose the most persuasive arguments for our narratives to have the proof-of-the-concept, or to test if we can have an effect on public good contributions at all. However, in practice, researchers can follow other methods and choose arguments that need to be addressed for some other reasons not related to their persuasive power.

Public good contributions

The main effect we study is the influence of narrative exposure on contributions to public good. Thus, in this section, we compare contributions across experimental sessions. First, we consider the effect of the general narrative structure on contributions. To test that, we pool together the data for the two versions of the narrative that have the same structure but are different in specific details. The left panel of Figure 5 shows the average proportions of the endowments contributed (further *contributions to public good*) for all data in Control 1, Treatment, and Control 2. The averages are 0.65, 0.77, and 0.67 respectively. The average contributions in Treatment are 18% higher than in both controls, which is a significant increase (rank-sum test - Control 1: $p = .0103$; Control 2: $p = .0243$).

The right panel of Figure 5 shows the Gaussian-smoothed distributions of contributions in the three experimental sessions. Notice that the distributions in both controls are
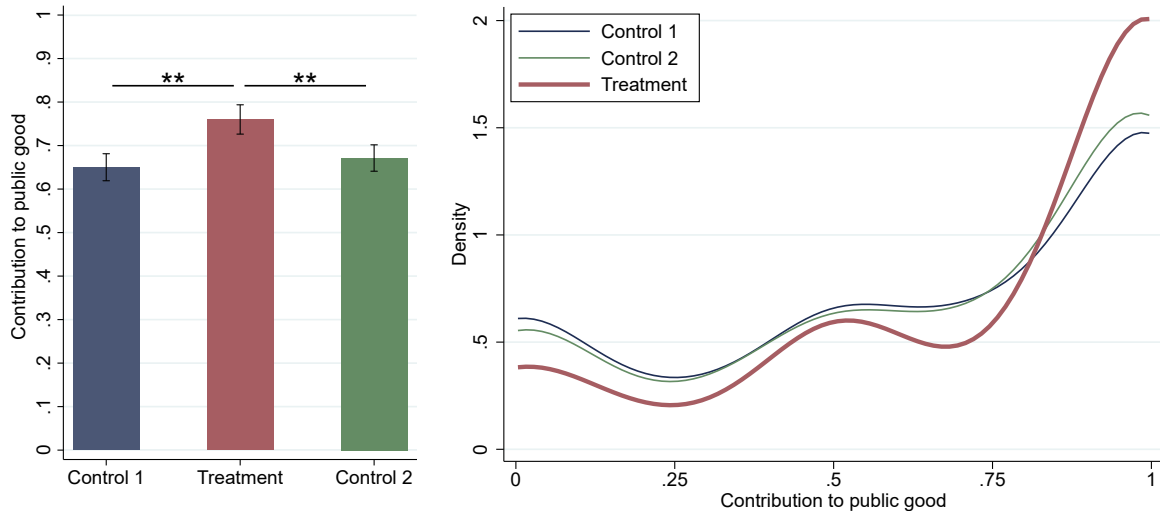
Fig. 5. Left Panel. Average percentages of the endowment contributed to public good by experimental session (** - $p < 0.05$). **Right Panel.** Distributions of contributions to public good.

almost identical, which suggests that this is a good measure that is stable in time (at least in the context of nuclear energy) even despite the fact that between the two control sessions a significant change in the debate over nuclear energy had occurred (see below). Next, notice that in Treatment more subjects than in controls choose to contribute 100% of the endowment and fewer subjects choose to contribute smaller amounts. This suggests that the general narrative structure inspires subjects, who would contribute less without reading the narrative, to contribute full amounts. Both the increase in the proportions of subjects who contribute full amounts and the decrease in the proportions of subjects who contribute less are significantly different between Treatment and controls (see Supplementary material S4 for the analysis).

Next, we consider separately the effects of the two versions of the narrative. The analysis presented in Supplementary material S3 shows that the average contributions for Narratives 1 and 2 are almost identical and are both significantly higher than in controls (in Control 1 at 5% level and at 10% level in Control 2 for both narratives). Similarly, the distributions of contributions for the two narratives are essentially the same. These observations suggest that the specific details of the narratives exert much less effect on contributions than the general narrative structure. Notice that from our data we cannot uncover the effects of the two narratives on the specific clusters, since we did not collect the survey answers in Treatment to divide participants into them. More research is needed to understand this influence.

Effectiveness of narratives

Despite the seeming irrelevance of the narrative details for the increased contributions to the public good on the population level, we find that some specific characteristics of the two narratives nonetheless did have differential effects on contributions. Though, these effects are not visible in the average contributions that are the same for the two narratives. So, we suggest that interpretations of these measures are used with caution.

Following previous studies on "narrative persuasion" and "narratives as tools for influencing policy change" [10, 6], we

Table 1. OLS robust regressions of contribution to public good on five measures of perception of a narrative. * - $p < 0.1$; ** - $p < 0.05$; *** - $p < 0.01$.

	Narrative 1		Narrative 2	
Congruence2	.074**	.091***	.083*	.048
	[.029]	[.030]	[.042]	[.033]
Manipulation	-.009	-.016	-.090**	-.068**
	[.032]	[.033]	[.042]	[.033]
Congruence1	.018		.011	
	[.020]		[.022]	
Trust	-.033		-.039	
	[.044]		[.057]	
Identification	.045		-.039	
	[.028]		[.035]	
Constant	.356	.374**	.953**	.728***
	[.272]	[.178]	[.360]	[.213]
N observations	56	56	49	49
R^2	.25	.19	.17	.14

used five measures described in more detail in Supplementary material S7.4 to estimate how subjects perceived the narratives to, in the end, influence their willingness to pay. Table 1 presents regression analyses of the effects of these measures on contributions. Notice that Congruence2, or agreement with the statement *"The story was about what I think is important in the nuclear power debate,"* had a significant positive impact on contributions in Narrative 1. Congruence2 was only a marginally significant predictor of contributions to the public good for Narrative 2. Manipulation, or agreement with the statement *"The person in the story comes across as manipulative,"* had a significant negative impact on contributions in Narrative 2.

The first effect suggests that some subjects primarily liked Narrative 1 because it was about what they think is important and, as a result, contributed more to public good. The second effect suggests that some subjects found Narrative 2 manipulative and decreased their contributions.

To summarize, the analysis of measures like these can provide additional information about the effectiveness of the constructed narratives and can help to check if a narrative is

too manipulative or congruent with the current perception of the issue.

Self-reported willingness to pay

In some situations it is not feasible to test narratives with an incentivized tasks like the Public Goods game, but only with simple questions. To check if our methodology works with such measures, we elicited self-reported willingness to pay for nuclear energy on a 7-Likert scale (agree-disagree). The question we asked is the following: *"I want to help pay for the construction of more nuclear power plants in the Netherlands."* The results for this measure reported in Supplementary material S5 are very similar to our analysis above: all main effects are the same. Though, the self-reported measures are more variable in time. This suggests nonetheless that simple questions can be used in practice to test the possible effect of narratives on economic behavior.

Additional checks

In this section, we discuss some additional results and checks that can be important when applying our methodology. First, we notice that 45 subjects who took part in both Control 1 and Treatment did not react to narratives as much as other subjects who had not participated in Control 1 (repeated subjects did not change their average contribution to public good after the exposure to a narrative). Supplementary material S6 provides the analysis. We conjecture (without evidence) that this difference with repeated subjects is due to the fact that they have chosen in the Public Goods game twice and might have remembered what they chose before. Though, we still find that the same narrative characteristic (Congruence2) does influence the contributions to public good in the same way as for non-repeated subjects.

Second, we would like to emphasize that the Public Goods game in Control 1 was different from those in Treatment and Control 2. Specifically, in Control 1 subjects had endowment of 2 Euro, while in the other sessions the endowment was 1 Euro. This was done for the purpose of testing whether the amount of endowment matters for framed Public Goods games as this one. We found that the endowment had no effect on the results as the distributions of contributions in Control 1 and Control 2 are virtually identical (see Figure 4). This suggests that Public Goods games framed for specific topic are not sensitive to the size of the endowment (at least as long as it is not too large).

Third, we would like to mention that between Treatment and Control 2 a significant development in the nuclear energy debate in the Netherlands took place. The government agreed to build two new nuclear plants in Zeeland, thus resolving the debate in favor of supporters of nuclear energy. It is important to keep track of such events, as they might influence subjects' attitudes and willingness to pay. Interestingly, we find that contributions to public good did not change due to this event (see Figure 4). However, as we document in Supplementary material S5, the self-reported willingness to pay did change between the two controls. This suggests that events related to the narratives might change subjects' attitudes, though not all of them. We leave it to future research to understand this in more detail.

Fourth, we collected a lot of additional demographic information about our subjects including various measures of economic behavior. We found no significant effects of any demographic variables or other measures on contributions to public good, except for a slight effect of the propensity to follow norms that was measured using the task of Kimbrough and Vostroknutov [15]. We find that the measured propensity to follow norms positively correlates with the contributions to public good in both controls separately (Spearman's rank correlation: Control 1 - $\rho = .15; p = .0656$; Control 2 - $\rho = .17; p = 0.0367$) and together ($\rho = .16; p = 0.0063$). The correlation is not significant in Treatment, which suggests that subjects with low propensity to follow norms increase their contributions in Treatment in comparison to controls. Overall, the significant correlation in controls suggests that the behavior of subjects is driven by norms to some extent. We did not find a correlation of propensity to follow norms with the self-reported willingness to pay.

The ethical use of narratives in democratic will-formation and policy implementation

We have shown that our methodology can be used to change people's behavior related to an economically important subject. But a serious concern arises that narratives created by this method can be used for nefarious purposes and manipulation. Notice that technologies for manipulating people's opinions and preferences using narratives already exist in abundance and are widely used. For example, emotionally loaded stories used in marketing and TV commercials are almost identical in style to ours: they describe the feelings of fictional protagonists that inspire observers to buy certain products. Thus, anyone who wishes to create a narrative for nefarious purposes does not have to go through the complex method described here and can simply use more traditional means.

To discuss the appropriate use of narratives in economic policy, we distinguish the process of *democratic will-formation* from the subsequent *policy implementation*. This distinction is closely linked to the distinction of using narratives for *comprehension* or *persuasion*:

> "Do I want to facilitate potential controversy through greater understanding or reduce potential controversy through greater acceptance? Can I justify manipulating my audience?" [7, p. 610]

The will-formation calls for maximized mutual understanding of perspectives and arguments and requires generating attention to ongoing debates and decision points. Narrative comprehension can support democratic will-formation, for example, by making the relevance of technology for different lifeworlds better understood. But still, the selection and encouraged dissemination of popular narratives might exclude unpopular ones from the debate because medial space and peoples' attention are limited. Besides, it remains an open question if co-existing narratives deepen or mediate value conflicts.

Reaching consensus or agreement with narrative persuasion stands against the ideal of deliberative democracy's "unforced force of the better argument" – unless one understands narratives that aim at comprehension as a means for including marginalized groups in an otherwise elitist discourse [16]. An ethical perspective on means and action (deontology) might generally discourage the use of narratives due to the tenuous influence on people's deliberation and autonomy, especially when only selected arguments and value preferences are represented [7]. However, from the perspective of consequences

(consequentialism), one can justify the use of narratives in will-formation by stating that the value of raising public awareness or even advocating for a specific or a neglected perspective in debates, such as for example nuclear waste management, is greater than the independent will-formation [30]. As both, a healthy environment and democratic standards are perquisites for free will-formation and higher-level organisation of economic and political actors, one can in principle justify the use of persuasive narratives in will-formation by the end of maintaining systemic perquisites of people telling stories and democracy. Still, this requires the democratic discussion of individual cases.

Narrative persuasion can also aid in implementing democratic decisions at lower costs. The greater good of a healthier or more sustainable behavior might justify using narratives with persuasive intention as a form of "governance," especially when actors with commercial interests dominate the arena. To better understand and assess cases when actors have ulterior motives or can use knowledge as power, virtue ethicists might call for more narrative literacy. This includes ways of how narratives disguise or selectively highlight information (framing), claim realism and relevance in their indices and references (authority), and bypass or trigger rational reflection (transportation).

The aim of this project is not only to suggest and test narratives as a tool for economic policy but also to better understand the existing role of narratives in personal psychology, formation of beliefs, and decision-making. Especially in policy-related fields, a hermeneutic of popular stories provides insights into how people make sense of policy or technology issues [11]. Thus, taking such stories seriously and discussing persuasive features can help to include people who would have been otherwise excluded from a discourse that only relies on rational argumentation. Our approach also suggests to not reduce narratives only to a medium that conveys information and values into a rational deliberation but also as a tool for encouraging people to tell and listen to each other's stories as part of empowerment and community creation.

Our project envisions to transform the construction of narratives for specific welfare-enhancing purposes into a transparent sequence of steps that everyone can verify and discuss in an analytical framework. Indeed, all ingredients of the narratives that we created have a well-documented and well-defined reason that can be traced to the responses of subjects in Control 1 and the general purpose of the narrative being constructed. Thus, our method provides *accountability* for the created narratives that is crucial for using narratives as a tool of economic policy. If a public institution chooses to use a fictional narrative, it can provide a report in public access that documents how this narrative was created and what purposes it serves. This transparency allows for arguing against the view that *all narratives* are used for pursuing nefarious purposes. If people know that the narrative was created by a public institution for a specific welfare-enhancing purpose in a transparent way, their use might become more legitimate. Overall, the accountability and transparency proposed by our method can help to fight misinformation rather than promulgate it. Still, using narratives and pointing to authorship and transparency is not a silver bullet either to overcome the broader legitimization issues in a population that is suspicious of democratic institutions, the sciences, and public mass-media discourse.

Limitations and future directions

Given the novel methodology of this study, it inherently faces certain limitations, thereby paving the way for future research opportunities. Since a between-subject design was deployed, the study focuses on aggregate population-level effects of narrative exposure. Repeated measurement of a subgroup of our sample did not generate sensible data, potentially due to participant recognition of the experiment upon re-exposure. This leaves a gap in understanding which participant groups were most strongly influenced by the narratives. The regression analysis indicates that participants experiencing narratives with high congruence and low manipulation were more inclined to contribute, yet this analysis method cannot test for a causal relationship. Future research could employ a within-subject design to understand better the differential impacts of various narratives on individuals with diverse prior attitudes.

Additionally, our experiment prioritized internal validity using a convenience sample. Future studies should aim to replicate these findings in a nationally representative sample to enhance the generalizability of the results. This is especially critical for applying this methodology to craft and assess narratives for public institutions.

Our experiment deployed a short temporal gap between narrative exposure and behavioral measurement. This contrasts with real-world scenarios where narrative exposure and subsequent behavioral or voting actions are often more temporally separated. Therefore, investigating the long-term effects of narrative exposure remains a crucial area for future research.

We acknowledge the inherent demand effects in narrative experiments, as narratives invariably include implicit moral directives. While our findings suggest that these demand effects did not significantly impact the internal validity of our experiment, as indicated by the consistent behavior of repeat participants, further research is needed to compare the influences of experimenter-driven versus institutional narrative demands on behavior.

Our approach explains persuasion and behavioral change with narrative-triggered inferences of participants' beliefs. Since mental states are basically opaque to both participants and external observers, we understand surveyed beliefs as both, uttered descriptions ("de re") of, e.g., nuclear power to be a solution to energy independence, and as a participant's truthful commitment ("de dicto") to making such claims premise for subsequent discourse, imaginative exercise, and action in the public good game [3]. We do not evaluate if the commitment is empirically true in the sense of matching mental states (that are opaque) but, just as with regular conversations, if it meets the social conventions of a survey context that allow for such understanding. We, therefore, interpret the surveyed change of argument agreement after narrative exposition as a change of commitment in reaction to narrative induced inferences of colligated descriptive claims.

Finally, we suggest future research to examine the effect of presented narrative features by systematic variation, their impact on dissemination, the specific mechanisms of narrative persuasion, and the use of large language models (LLMs), such as LLaMA2 or GPT3, to aid the systematic construction of narratives as described.

Conclusion

In this study, we test a novel methodology that allows to construct fictional narratives targeted at a specific topic and a specific population. We show that the narratives we have constructed do increase contributions in the Public Goods game, specifically framed for the purpose, and also increase self-reported willingness to pay for nuclear energy in the Netherlands. We showcase several diagnostic tools that can be used to check how well a narrative was perceived and its various effects on behavior and beliefs.

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Supplementary material

Supplementary material is available at PNAS Nexus online.

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Author contributions statement

L.L., M.R., and A.V. worked together on the idea of the project. L.L. and M.R. constructed narratives. L.L. and A.V. designed the experiment. L.L. programmed the experiment, ran the experiment, and analyzed the data. L.L., M.R., and A.V. wrote and revised the manuscript.

Previous presentation

These results were never previously presented.

Data availability

The data underlying this article are available in OSF at https://osf.io/ptqsd/.

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Supplementary Material
**Narrative influence on support of a public policy:
the case of nuclear power in the Netherlands**
by Lotte de Lint, Maximilian Roßmann, Alexander Vostroknutov

S1 Narratives

S1.1 Narrative 1

A message from the future

We have known for a very long time that in order to avert global warming, we must cut our emissions. I did not see nuclear power to be a viable solution because of pending issues with its waste management. I must admit that I have personally fought against it for decades. Without a doubt, our efforts have had some results and we have successfully installed a lot of solar panels and wind turbines. If only the growth of our renewable energy sources had been adequate to shut down fossil fuel plants while maintaining a steady supply.

Now, 30 years later, I occasionally remember these times and start seeing things differently. When my kids and I bike in the tulip fields outside of town, they aren't exploring the lovely meadows of my youth. Nearby, where once was a beautiful lake, they only discover some dead trees, arid fields, and dirty trickles. I had been attempting to grow veggies next to our bike shed for a few years. It may seem sentimental, I wanted to instill in my children a little sense of kinship with our land and the natural world, just like my parents did. However, soon I gave up on this endeavor when it became clear that either it didn't rain at all during these scorching summers or that massive rains ruined a year's worth of labor. Everything in the garden died.

Personally, I have always fared well, and we have built up a certain prosperity. Of course, someplace had to provide the power for our cars, homes, and cities. It is only years later that I realize the extent of climate change when I see what's left of our gorgeous landscape. Technologies were available. But it's possible that we missed out on a safe and cleaner solution.

I regret much having underestimated how polluting our energy system was as I look back on my life. When we had the option, I regret that I was so stubborn and did not also consider nuclear plants for a reliable and secure energy source. I am sending you a message from the future: Do all in your power to avert climate change.

S1.2 Narrative 2

A message from the future

It was like an uneasy awakening when political dependencies put our homes' and companies' energy security at stake. Since there was a chance of a nuclear accident and the still unresolved waste management, I must acknowledge that I have spent decades opposing and fighting nuclear power. Additionally, nuclear power seemed to be no longer a viable option due to the rising affordability of renewable energy sources. If only the growth of our renewable energy sources had been adequate.

Now, 30 years later, I occasionally remember these times and start seeing things differently. In my profession, working with young adults, it is important to hold up and teach a hopeful and democratic prospect. But to be honest, this is getting more and more difficult. Some claim it began when we were given the option of freezing in the winter or making dubious bargains to secure electricity supplies. Of course, nobody wanted to wear caps and gloves at home in one's apartment. However, becoming more reliant on problematic dependencies to meet our unsaturable demand for steady energy turned out even worse.

The result is seen every day in the news: Along the way, we have lost our credibility selling out more and more of our values. Our western values that united us – are they just empty phrases to whitewash our Western lifestyle? We have become so dependent on imported gas, coal, and oil that our freedom is now torn between unpredictable weather and resource reliance.

I wish to maintain my optimism despite the difficulties, both for my pupils and for my friends and family. But it's possible that we overlooked the option for a reliable and independent solution, as technologies were available.

I greatly regret not realizing how delicate, and dependent our energy system was earlier in my life. When we had the option, I regret not also considering innovative nuclear plants as a way to reach our aspiration of independence. I am sending you a message from the future: Do not underestimate dependencies of a steady energy supply.

S1.3 Mapping of narrative structure and arguments

In this section, we describe the specific elements of the narratives that were constructed from the general narrative structure and the arguments chosen for each narrative. The narratives in S1.1 and S1.2 are color-coded to represent different elements of the design.

For the general narrative structure we chose the story of a middle-class Dutch individual in the future, who used to be a denier of benefits of nuclear energy, but 30 years later he regrets not having done more in the past. The parts of the narratives that reflect the setting and the character development along these general lines are coded in green. Note that the settings are deliberately chosen to feel familiar to Dutch people. The process of realization of past mistakes (not doing more about nuclear energy in the past) and consequent regret are expressed with emotional reactions of the protagonist.

The arguments chosen for the two narratives are coded in red (negative) and blue (positive). We chose to have both positive and negative arguments in each narrative because previous studies (e.g., O'Keefe, 1999, *Annals of the International Communication Association,* 22:1, 209-249) suggest that the mixture comes across as more persuasive than when only one-sided arguments are presented (which is seen as an attempt at manipulation). At least two positive and one opposing argument, with a minimum of four, were selected for inclusion in each narrative. This was done to ensure the balance across arguments. One positive argument was chosen as the central focus of each narrative.

For Narrative 1 that corresponds to the red cluster on Figure 4, we chose positive arguments Climate, Constant supply, and Safety, and negative argument Nuclear waste. The logic of choosing these arguments was the following. The three positive arguments are ranked as the most persuasive in terms of willingness to pay for nuclear energy (red cluster on the left panel of Figure 4) if we do not take into account Independence, which we use for the other narrative. The negative argument Nuclear waste was chosen as the one having the most negative effect on subjects' willingness to pay for nuclear energy to counterbalance the positive arguments.

For Narrative 2 corresponding to the blue cluster, we chose positive arguments Independence and Constant supply and negative arguments Destruction danger, Nuclear waste, and High cost. As before, Independence and Constant supply are the arguments that inspire the highest desire to pay for nuclear energy in the blue cluster (highest average values, see left panel of Figure 4). Similarly, Destruction danger and Nuclear waste
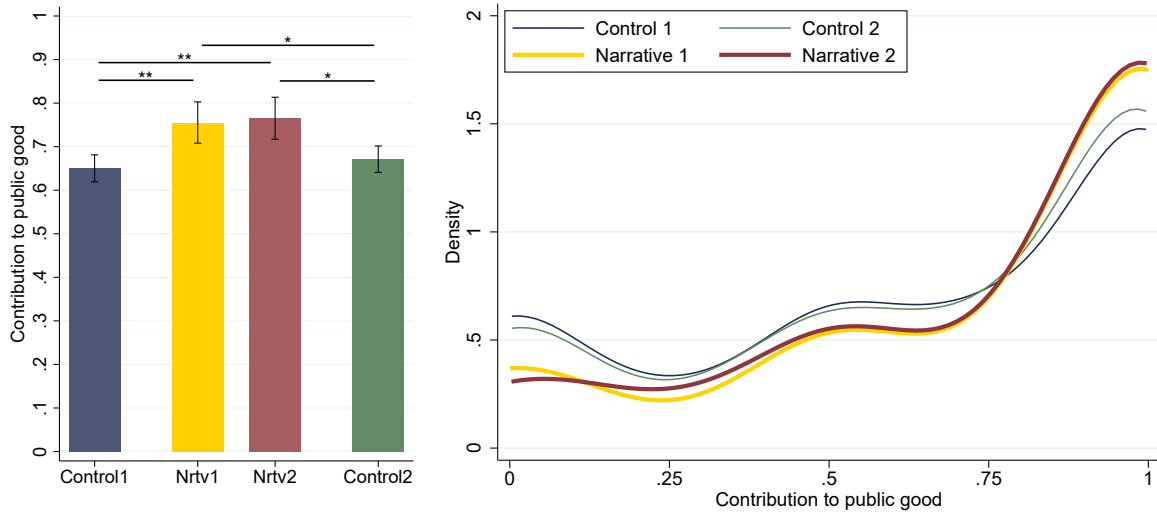
Fig. 6. Left Panel. Average percentages of the endowment contributed to public good in Control 1, Control 2, and Treatment divided into Narrative 1 and Narrative 2 ($*$ - $p < 0.1$; $**$ - $p < 0.05$). **Right Panel.** Distributions of contributions to public good.

are the arguments that people find the least persuasive in terms of paying for nuclear energy (roughly the least persuasive; we had to make some trade-offs).

S2 Details of cluster analysis

The optimal number of clusters was determined by employing the NbClust package in R, which uses a majority rule for 30 widely accepted tests (Charrad et al., 2014, *Journal of statistical software,* 61, 1-36). The optimal number of clusters for our dataset (Control 1) was two. Subsequently, the clusters were formed through K-means clustering.

S3 Analysis of the two narratives

The left panel of Figure 6 shows the contributions to public good in controls and separately for two Narratives presented in Treatment. The rank-sum tests between the contributions in Control 1 and the two narratives are significant at 5% ($p = .0489$ and $p = .0377$). The comparison of the contributions for each narrative with Control 2 are significant at 10% level ($p = .0715$ and $p = .0808$).

S4 Additional analysis of contributions

In the main text, we compared the distributions of contributions using non-parametric rank-sum tests that take into account whole distributions of variables. However, we also observed that the main shift in contributions in Treatment happened due to more subjects choosing full amounts to contribute. This suggests that we can run more detailed tests of the differences in contribution choices by looking at the proportions of subjects who choose certain amounts. For example, we can test if more subjects in Treatment chose full amount as compared to controls or some other proportion.

We define a dummy variable equal to 1 for subjects who made full contributions and 0 otherwise, and compare these variables across experimental sessions using binomial tests (we hypothesize that Treatment increases contributions). We find that the proportion of subjects who chose full amounts is

significantly different between Control 1 and Treatment (one-sided $p = .0068$; two-sided $p = .0135$), between Control 2 and Treatment (one-sided $p = .0068$; two-sided $p = .0135$), and between both controls and Treatment (one-sided $p = .0028$; two-sided $p = .0055$). These differences are also significant if we consider two narratives separately. For comparisons of either Control 1 or 2 with either Narrative 1 or 2 we get one-sided $p < 0.0268$ and two-sided $p < 0.0537$ (see also the right panel of Figure 6). This suggests that both narratives drive significantly more subjects to choose full contribution than in controls.

We can also run similar tests for subjects who chose less than full amount. We pool both control sessions and compare the proportions of subjects who chose contributions less than or equal to 0%, 25%, 50%, and 75% between pooled controls and Treatment. We find that the proportions of subjects are significantly lower in Treatment than in controls. The p-values for the four comparisons are respectively $p = .0635$, $p = .0424$, $p = .0468$, and $p = .0007$ (one-sided binomial tests under the hypothesis that Treatment increases contributions; the two sided versions of the p-values are $p = .1270$, $p = .0848$, $p = .0949$, and $p = .0014$). Thus, we can conclude that our narrative structure has driven a significant proportion of subjects from contributing lower amounts to contributing full amount.
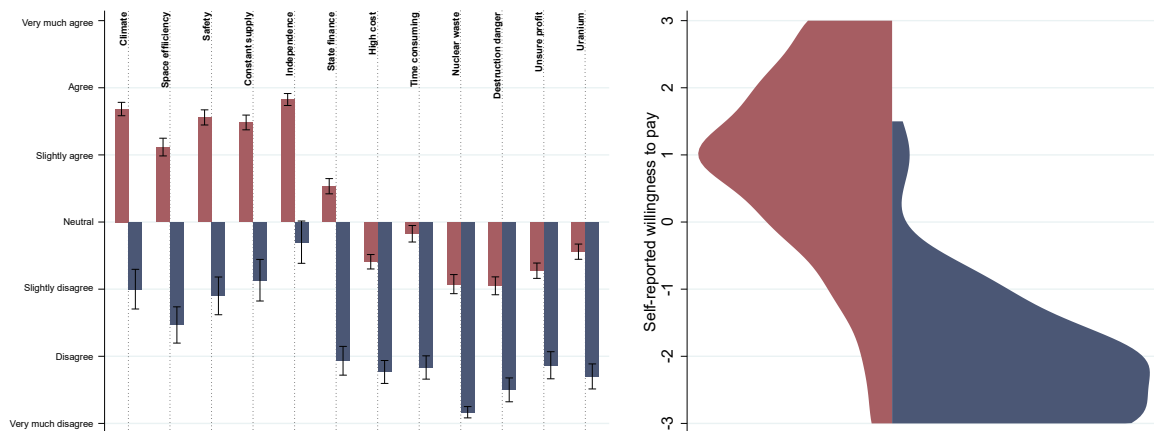
Fig. 7. Left Panel. Average answers to Argument Persuasiveness questions in the two clusters of subjects from Control 1. Error bars stand for standard errors. See Supplementary material S7.1 for the descriptions of the questions. **Right Panel.** Distributions of self-reported willingness to pay in the two clusters.

S5 Self-reported willingness to pay

Here, we present the same analysis as in the main text, only for the self-reported willingness to pay (SWTP) instead of contributions to public good. It is important to check whether we get similar results with this measure, as it is often the case that incentivized tasks (like the Public Goods game) are not possible to run.

Figure 7 shows the argument persuasiveness graph on the left (copied from the main text) and the distributions of SWTP in the two clusters. The distributions are significantly different (rank-sum test: $p < 0.0001$). The average SWTP in the red cluster is 0.84 and in the blue cluster -2.13. These results are in line with our findings for contributions to public good.

Next we focus on the comparisons of SWTP across experimental sessions. Figure 8 shows the same analysis as for the contributions. We see that SWTP in Control 1 is significantly different from Treatment (rank-sum test: $p = 0.0410$), and that no other comparisons are significant (the left panel of Figure 8). Notice that the two controls have rather different distributions of SWTP, and this is the reason why Treatment and Control 2 are not significantly different. We believe that the approval of new nuclear plants in Zeeland right before Control 2 might have to do with the change in Control 2 (though, we do not have evidence to support this claim).

The right panel of Figure 8 shows the distributions of SWTP in Control 1, 2, and Treatment. Here we observe an important difference from the analogous graph for contributions to public good. Notice that the narratives drive subjects to choose SWTP equal to 1 (slightly agree to pay), which is not the highest level possible as is the case with contributions. The distributions of SWTP in two controls look rather different, though not significantly different from each other.

When we compare the proportion of subjects who chose SWTP equal to 1 in different sessions, we find that one-sided binomial test (under the hypothesis that Treatment increases contributions) between pooled controls and Treatment is significant ($p = 0.0412$; two-sided $p = 0.0824$). This means that a significantly higher proportion of subjects chooses SWTP equal to 1 in Treatment as compared with controls. The comparison of proportions between Control 1 and Treatment yields $p = 0.0562$ and between Control 2 and Treatment we get $p = 0.0712$.

Also notice that the proportion of subjects who choose the lowest possible level of SWTP (-3) did not change in Treatment. This suggests that the narratives did not manage to change the personal opinions of the most vehement opponents of nuclear energy, but they did change their contributions to public good (we know from Figure 5 that zero contributions decrease in Treatment).

Notice as well that the narratives did have an effect on other subjects with negative SWTP. We see that much fewer subjects choose SWTP equal to -2 or -1 in Treatment as compared to Control 1. To see if this effect is significant, we compare the proportions of subjects who chose negative SWTP across sessions. One-sided binomial test between Control 1 and Treatment (under the hypothesis that Treatment increases contributions) gives a significant difference with $p = 0.0301$ (two-sided $p = 0.0602$). This shows that significantly less subjects chose negative SWTP in Treatment than in Control 1. The same test for Control 2 is not significant.

Next, we look at the two versions of the narrative structure separately. Figure 9 shows the results. On the right panel, we can observe that the two narratives create a slightly different distributions of SWTP. Narrative 1 seems to drive more subjects to choose SWTP equal to 1 than Narrative 2, though this difference is not significant. We find that the difference in distributions is only significant at 10% level between Control 1 and Narrative 1 (rank-sum test: $p = 0.0886$, see also the left panel of Figure 9).

When we look at the proportions of subjects choosing SWTP equal to 1 across narratives and controls, we find the only significant difference between Control 1 and Narrative 1 (one-sided binomial test under the hypothesis that Treatment increases contributions: $p = 0.0530$; two-sided $p = 0.1060$). This suggests that more subjects than in Control 1 choose SWTP equal to 1 after being treated with Narrative 1.

We find that the proportion of subjects who choose negative SWTP is significantly different between Control 1 and Narrative 1 (one-sided binomial test under the hypothesis that Treatment increases contributions: $p = 0.0336$; two-sided $p = 0.0672$). This shows that Narrative 1 significantly decreases the proportion of subjects with negative SWTP. Most likely, these subjects start choosing SWTP equal to 1 or higher.
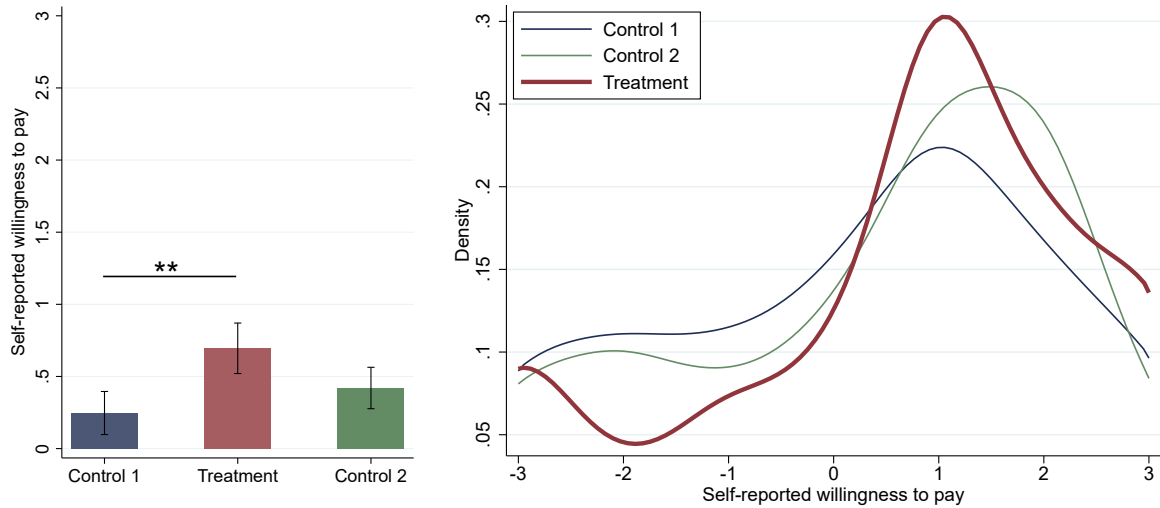
Fig. 8. Left Panel. Average self-reported willingness to pay by experimental session (∗∗ - $p < 0.05$). **Right Panel.** Distributions of self-reported willingness to pay.

Finally, we analyze the effects of narrative characteristics on SWTP. Table 2 presents the analysis in the same format as in the main text for the contributions to public good.

Table 2. OLS robust regressions of self-reported willingness to pay on five measures of perception of a narrative. * - $p < 0.1$; ** - $p < 0.05$; *** - $p < 0.01$.

	Narrative 1		Narrative 2	
Congruence2	.468***	.575***	.566**	.343*
	[.128]	[.134]	[.277]	[.187]
Manipulation	.005	-.081	-.401**	-.348*
	[.141]	[.145]	[.173]	[.183]
Congruence1	.151		-.150	
	[.117]		[.170]	
Trust	-.042		-.066	
	[.165]		[.265]	
Identification	.215		-.210	
	[.162]		[.267]	
Constant	-2.732**	-1.750**	.892	.029
	[1.262]	[.846]	[1.403]	[1.034]
N observations	56	56	49	49
R^2	.39	.31	.23	.17

We see that SWTP reacts to Narratives 1 and 2 in a way similar to contributions to public good. Specifically, in Narrative 1 subjects who find the narrative important (Congruence2), also choose higher SWTP. In Narrative 2, we observe the same negative effect of manipulation as with contributions. Thus, contributions to public good and SWTP are similarly affected by the details of each narrative.

S6 Repeated subjects

After we ran Control 1, we allowed subjects who took part in it to also participate in Treatment. The reason was to see the effect of being exposed to two experiments related to nuclear energy and whether participation in Control 1 had an effect on the behavior in Treatment.

Interestingly, we did find that 45 subjects who participated in both Control 1 and Treatment behaved differently. For

example, these subjects did not significantly increase their contributions to public good in Treatment as compared to Control 1 (average contributions are .61 in Control 1 and 0.59 in Treatment). This may be so because subjects during Treatment remembered the amounts they contributed in Control 1. This is also suggested by the fact that we do find a significant effect of narrative characteristics on the contributions of repeated subjects. Specifically, the OLS robust regression of their contributions in Treatment on the five narrative characteristics (as in Table 1) gives a significant coefficient on Congruence2, similarly to our findings in the main text. This shows that some repeated subjects do respond to the congruence of the narratives and increase their contributions. However, such increase is not large enough to change the average contributions.

To assess whether self-selection bias influenced repeated participation in our experiment, we analyzed if nuclear power support indicators significantly predicted individuals' choosing to participate again. Table 3 presents these findings, revealing that only space efficiency and state finance arguments predict repeated participation at 10% level ($p < 0.1$). Consequently, this regression analysis provides no substantial evidence of systematic self-selection effects occurring in our study.
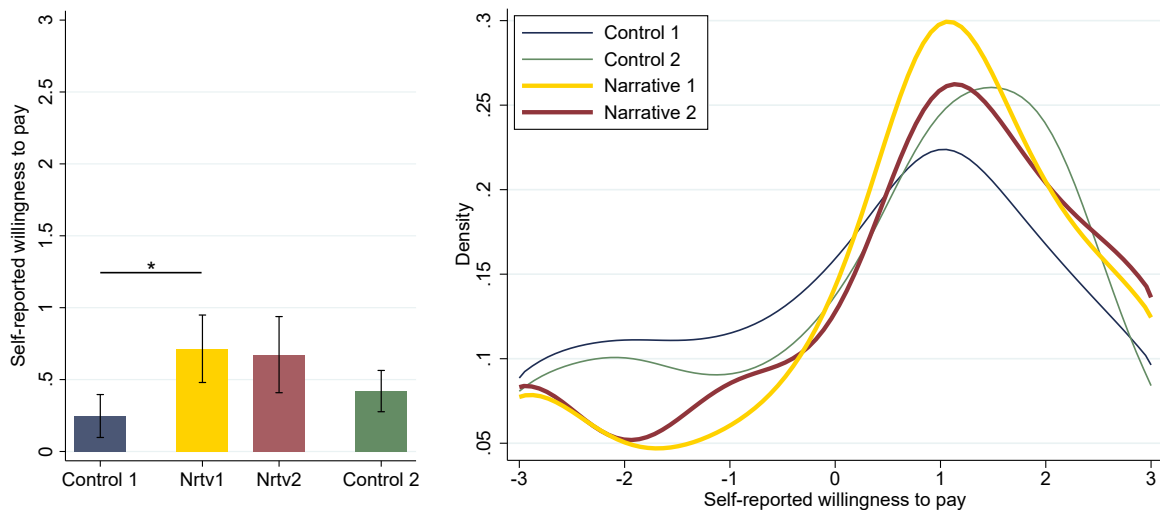
Fig. 9. Left Panel. Average self-reported willingness to pay in Control 1, Control 2, and Treatment divided into Narrative 1 and 2 (∗ - $p < 0.1$).
Right Panel. Distributions of self-reported willingness to pay.

Table 3. Binary logistic regression of repeated participation on nuclear power support indicators measured at Control1. ∗ - $p < 0.1$; ∗∗ - $p < 0.05$; ∗∗∗ - $p < 0.01$.

WTP	-.339
	[.746]
Self-reported WTP	.154
	[.198]
Climate	-.013
	[.188]
Space efficiency	0.332*
	[.173]
Safety	-.283
	[.201]
Constant supply	-.347
	[.247]
Independence	.114
	[.236]
State finance	.316*
	[.186]
Cost	-.145
	[.189]
Time consumption	-.006
	[.174]
Nuclear waste	-.199
	[.184]
Destruction	-.002
	[.202]
Unsure profit	-.242
	[.190]
Uranium	-.120
	[.172]
Constant	-1.211**
	[.600]
N observations	150
Pseudo R^2	.08

S7 Instructions (English translation)

S7.1 Argument persuasiveness

Please indicate how the statements below change your opinion about the following statement:

"I want to help pay for the construction of more nuclear power plants in the Netherlands."

(very much disagree; disagree; slightly disagree; neutral/no effect; slightly agree; agree; very much agree)

Climate More nuclear power will help us to meet the climate goals

Space efficiency Nuclear power plants are more space efficient than other green power sources like wind and solar

Safety Nuclear power is safer than energy from coal; It causes fewer deaths per unit of energy produced

Constant supply Unlike solar panels and wind turbines, nuclear power plants deliver a constant, reliable amount of energy.

Independence More nuclear power plants increase our independence from other nations for our energy needs.

State finance New nuclear power plants will have to be partially financed by the state because private parties see it as a high-risk investment.

High cost Building new nuclear power plants is expensive, with many recent plants going over budget.

Time consumption Nuclear power plants take a long time to build, and their benefits come late.

Nuclear waste Nuclear energy production creates radioactive waste

Destruction danger A nuclear power plant might fail and cause much damage

Unsure profit It is unsure whether a new nuclear power plant will be profitable since it is uncertain what the energy prices will be when the plant becomes operational.

Uranium Uranium reserves are limited.

S7.2 Public Goods game

The Dutch government is planning to build new nuclear power plants. To make this possible, we will have to help pay for its construction together.

In the hypothetical scenario of this study, you have 1 Euro to divide between the following choices. Option 1: You keep the money yourself or Option 2: You use the money to help pay for the construction of nuclear power plants.

The money put into Option 2 by all survey participants will be pooled. This money will become worth 1.5 times more, after which the amount increased in value will be divided equally among all participants.

This mechanism mimics the following future scenario:

- Investing in Option 2 creates more nuclear power plants;
- This results in a lower energy bill;
- Thereby, there is a money saving that is equal for everyone.

The participants in this study are random people from the Netherlands.

Your income = (Money from Option 1) + (Money from Option 2 from all participants * 1.5) / (Number of participants)

Calculation example:

All participants (and you) choose Option 1 ⇒ Your income: 1 Euro

All participants (and you) choose Option 2 ⇒ Your income: 1.5 Euro

So your income from Option 2 depends on how much the other research participants invest in nuclear power plants.

The outcome of this assignment will be paid to you in cash.

Make the same choice you would make in real life.

S7.3 Self-reported willingness to pay

What is your opinion about the following statement?

I want to help pay for the construction of more nuclear power plants in the Netherlands. (Very much agree; Agree; Slightly agree; Neutral; slightly disagree; Disagree; Very much disagree)

S7.4 Narrative characteristics

(1: not at all, ..., 7: very much)

Congruence 1 The story was consistent with how I view nuclear power.

Congruence 2 The story was about what I think is important in the nuclear power debate.

Trust The person in the story comes across as a trustworthy and honest person.

Manipulation The person in the story comes across as manipulative.

Identification I could identify with the person in the story.

S7.5 Rule-following task

In this question you can earn an additional small amount of money. You will decide how to allocate 10 balls between two buckets, a yellow bucket and a red bucket. For each ball you put in the red bucket, you will receive 1 cent, and for each ball you put in the yellow bucket, you will receive 2 cents.

The rule is to put the balls in the blue bucket.

Your payment will be based on your decisions: it is the sum of payments from the red and yellow buckets. You can choose any allocation of the balls. Your decision will have no consequences except for the payment as described above.

S8 Instructions (Dutch original)

S8.1 Argument persuasiveness

Geef aan hoe de hieronder genoemde statements uw mening veranderen over de volgende stelling:

"Ik wil meebetalen aan de bouw van meer kerncentrales in Nederland."

Climate Meer kernenergie zal ons helpen de klimaatdoelstellingen te halen

Space efficiency Kerncentrales zijn ruimte-efficiënter dan andere duurzame energiebronnen zoals wind- en zonne-energie.

Safety Kernenergie is veiliger dan energie uit steenkool; het veroorzaakt minder doden per eenheid aan geproduceerde energie.

Constant supply Kerncentrales produceren een constantere, en daarmee een meer betrouwbare, energietoevoer dan zonnepanelen en windmolens.

Independence Meer kerncentrales zorgen ervoor dat we minder afhankelijk zijn van andere landen voor onze energiebehoefte.

State finance Nieuwe kerncentrales zullen deels door de staat gefinancierd moeten worden, omdat private partijen het als een risicovolle investering zien.

High cost De bouw van nieuwe kerncentrales kost veel geld, en veel recente centrales overschrijden het budget.

Time consumption De bouw van kerncentrales neemt veel tijd in beslag, waardoor we pas ver in de toekomst (over 5-10 jaar) profijt ervan hebben.

Nuclear waste De productie van kernenergie veroorzaakt radioactief afval.

Destruction danger Een kerncentrale kan problemen krijgen en veel schade aanrichten.

Unsure profit Het is niet zeker of een nieuwe kerncentrale rendabel zal zijn aangezien het onzeker is hoe hoog de energieprijzen zullen zijn op het moment dat de centrale operationeel wordt.

Uranium Uraniumreserves zijn beperkt en kunnen opraken.

S8.2 Public Goods game

Er wordt door de Nederlandse overheid plannen gemaakt om nieuwe kerncentrales te bouwen. Om dit mogelijk te maken zullen we samen moeten meebetalen aan de bouw hiervan.

In het hypothetische scenario van dit onderzoek heeft u 2 euro om te verdelen over de volgende keuzes. Optie 1: U houdt het geld zelf of Optie 2: U gebruikt het geld om mee te betalen aan de bouw van kerncentrales.

Het geld dat door alle onderzoeksdeelnemers in Optie 2 wordt gestopt zal worden samengevoegd. Dit geld wordt 1,5 keer meer waard, waarna het in waarde gestegen bedrag gelijk over alle deelnemers zal worden verdeeld.

Dit mechanisme bootst het volgende toekomstscenario na:

- Investeren in optie 2 zorgt voor meer kerncentrales.
- Dit veroorzaakt een lagere energierekening.
- Daarmee is er een geldbesparing die voor iedereen gelijk is.

De deelnemers uit dit onderzoek zijn willekeurige mensen uit Nederland.

Uw inkomsten = (Geld uit Optie 1) + (Geld uit Optie 2 van alle deelnemers * 1.5) / (Aantal deelnemers)

Rekenvoorbeeld:

Alle deelnemers (en u) kiezen Optie 1 ⇒ Jouw inkomsten: 2,-

Alle deelnemers (en u) kiezen Optie 2 ⇒ Jouw inkomsten: 3,-

Uw inkomsten uit optie 2 zijn dus afhankelijk van hoeveel de andere onderzoeksdeelnemers investeren in kerncentrales.

De uitkomst van deze opdracht wordt aan u uitbetaald in geld.

Maak de keuze die u in het echte leven ook zou maken.

S8.3 Self-reported willingness to pay

Wat is uw mening over de volgende stelling?

Ik wil meebetalen aan de bouw van meer kerncentrales in Nederland. (Zeer oneens; Oneens; Beetje oneens; Neutraal; Beetje eens; Eens; Zeer eens)

S8.4 Narrative characteristics

(1: helemaal niet, ..., 7: heel erg)

Congruence 1 Het verhaal kwam overeen met hoe ik tegen kernenergie aankijk.

Congruence 2 Het verhaal ging over wat ik belangrijk vind in het kernenergiedebat.

Trust De persoon in het verhaal komt over als een betrouwbaar en eerlijk persoon.

Manipulation De persoon in het verhaal komt manipulatief over.

Identification Ik kon mij identificeren met de persoon uit het verhaal.

S8.5 Rule-following task

Met deze vraag kunt u een klein extra bedrag verdienen. U beslist hoe u 10 ballen verdeelt over twee emmers, een gele emmer en een rode emmer. Voor elke bal die u in de rode emmer doet, krijgt u 1 cent, en voor elke bal die u in de gele emmer doet, krijgt u 2 cent.

De regel is om de ballen in de rode emmer te doen.

Uw betaling wordt gebaseerd op uw beslissing: het is de som van het geld dat u krijgt uit de rode en de gele emmer. U kunt elke verdeling van de ballen kiezen. Uw beslissing zal geen gevolgen hebben behalve de betaling zoals hierboven beschreven.

S9 Narratives (Dutch original)

S9.1 Narrative 1

Een boodschap uit de toekomst

We weten al heel lang dat we onze uitstoot moeten verminderen om de opwarming van de aarde tegen te gaan. Vroeger zag ik kernenergie niet als een realistische oplossing vanwege het nucleaire afvalprobleem. Ik geef toe dat ik me er persoonlijk tientallen jaren tegen heb verzet. Met succes installeerden we echter wel velen zonnepanelen en windturbines. Onze acties tegen klimaatverandering hebben effect gehad, zonder twijfel. Was de energie uit onze hernieuwbare bronnen maar consistent en genoeg geweest om alle kolencentrales te kunnen sluiten.

Nu, 30 jaar later, denk ik af en toe terug aan vroeger en kijk ik anders tegen de dingen aan. Wanneer mijn kinderen en ik nu door de polders fietsen, verkennen we niet meer de mooie tulpenvelden uit mijn jeugd. Hier vlakbij, waar ooit een prachtige plas was, ontdekken ze nu alleen wat dode bomen, dorre velden en vieze stroompjes. Ik probeer nu al een paar jaar groenten te kweken naast ons fietsenhok. Het lijkt misschien sentimenteel, maar ik wilde mijn kinderen een beetje verbondenheid met ons land en de natuur bijbrengen, net zoals mijn ouders dat hebben gedaan. Maar ik heb het al snel opgegeven toen er duidelijk werd dat het ofwel helemaal niet regende tijdens de snikhete zomers ofwel dat massale regenval een jaar aan werk volledig wegspoelde. Alles in de tuin ging dood.

Persoonlijk heb ik altijd goed geboerd, en hebben we een zekere welvaart op kunnen bouwen. Natuurlijk moest de energie voor onze auto's, huizen en steden ergens vandaan komen. Als ik zie wat er nu nog maar over is van onze ooit zo prachtige natuur, besef ik me jaren later de schade die klimaatverandering heeft aangericht. Maar het is goed mogelijk dat we de optie voor een betrouwbare en onafhankelijke oplossing zijn mis gelopen, terwijl de technologie wel beschikbaar was.

Als ik terugkijk op mijn leven zie ik dat ons energiesysteem veel vervuilender was dan ik eerst dacht. Ik heb er spijt van dat ik te koppig was. Toen we de keus hadden, wilde ik gewoon niet inzien dat kernenergie ook een betrouwbare en veilige energiebron was. Daarom stuur ik je een boodschap uit de toekomst: Doe er alles aan om klimaatverandering te voorkomen.

S9.2 Narrative 2

Een boodschap uit de toekomst

Het was een shock toen ik me realiseerde dat de energiezekerheid van onze huizen en bedrijven opeens op het spel stond door politieke afhankelijkheden. Door de kans op een kernramp en het onopgeloste probleem van kernafval, moet ik toegeven dat ik me tientallen jaren verzet heb tegen kernenergie. Bovendien leek kernenergie niet langer een haalbare optie doordat duurzame energie steeds goedkoper werd. Was de groei van duurzame energie maar genoeg geweest.

Nu, 30 jaar later, denk ik af en toe terug aan vroeger en kijk ik anders tegen de dingen aan. Binnen mijn werk met jongvolwassenen, is het belangrijk om een hoopvol en democratisch perspectief te schetsen. Maar eerlijk gezegd wordt dit steeds moeilijker. Sommigen beweren dat het allemaal begon toen we de keuze kregen tussen kou leiden in de winter of dubieuze deals sluiten om onze toegang tot energie zeker te stellen. Natuurlijk zat niemand erop te wachten om thuis mutsen en wanten te moeten dragen. Echter, door onze onverzadigbare vraag naar een constante energietoevoer werden we steeds afhankelijker van problematische partijen. Het resultaat is dagelijks in het nieuws te zien: Gaandeweg hebben we onze geloofwaardigheid verloren door steeds meer van onze waarden aan de kant te schuiven. Onze westerse waarden die ons verenigden - zijn dat slechts holle uitdrukkingen om onze Westerse levensstijl goed te praten? We zijn zo afhankelijk geworden van geïmporteerd gas, steenkool en olie dat onze vrijheid nu wordt ingeperkt door onvoorspelbaar weer en onze afhankelijkheid van grondstoffen.

Ik wil ondanks alle problemen vasthouden aan mijn optimisme voor zowel voor mijn leerlingen als voor mijn vrienden en familie. Maar het is goed mogelijk dat we de optie voor een betrouwbare en onafhankelijke oplossing zijn mis gelopen, terwijl de technologie wel beschikbaar was.

Als ik terugkijk op mijn leven zie ik dat ons energiesysteem veel kwetsbaarder en afhankelijk was dan ik eerst dacht. Ik heb er spijt van dat ik te koppig was. Toen we de keus hadden, wilde ik gewoon niet inzien dat innovatieve kerncentrales een manier zijn om onafhankelijker te worden. Daarom stuur ik je een boodschap uit de toekomst: Onderschat niet hoe afhankelijk wij zijn voor onze stabiele energievoorziening.

S10 Demographics

Table 4. Demographic Information Per Experiment

Variable	Value	Control 1	Treatment	Control 2
Sex	Male	50%	50%	50%
	Female	50%	50%	50%
Age	Mean (SD)	31.0 (10.2)	30.2 (10.7)	28.1 (7.57)
Education	Doctoraat, PhD	2.0%	0.7%	2.0%
	Master (HBO / WO)	21%	21%	27%
	Bachelor (HBO / WO)	45%	47%	41%
	HAVO, VWO, MBO2-4	28%	27%	29%
	VMBO, HAVO / VWO onderbouw, MBO1	2.0%	3.0%	2.0%
	Primary school	0%	0.7%	0%
	Other	1.3%	0%	0%
Religiosity	True	29%	16%	22%
	False	71%	84%	78%
Ethnicity	North- and/or West-European (including North-America/ Oceania)	80%	81%	77%
	Other	20%	19%	23%
Political affiliation	BBB	0%	0%	0.7%
	CDA	1.3%	0%	0.7%
	ChristenUnie	1.3%	2.0%	1.3%
	D66	10%	10%	12%
	Forum voor Democratie	2.0%	0.7%	1.3%
	GroenLinks	18%	15%	16%
	Ja21	2.0%	4.0%	4.7%
	Partij voor de Dieren	11%	10%	6.0%
	PvdA	6.0%	5.3%	5.3%
	PVV	6.0%	4.0%	2.0%
	SGP	0.6%	1.3%	0.7%
	SP	4.0%	2.7%	3.3%
	Volt	6.0%	9.3%	11%
	VVD	5.3%	9.3%	8.0%
	Other	7.3%	4.0%	4.0%
	I do not know	19%	20%	23%
Number of subjects		150	150	150