TU Delft

Delft University of Technology

# Policy Sandboxing

## Empathy As An Enabler Towards Inclusive Policy-Making

Mauri, Andrea; Hsu, Yen-Chia; Verma, Himanshu; Tocchetti, Andrea; Brambilla, Marco; Bozzon, Alessandro

**DOI**
10.1145/3686908

**Publication date**
2024

**Document Version**
Final published version

**Published in**
Proceedings of the ACM on Human-Computer Interaction

**Citation (APA)**
Mauri, A., Hsu, Y.-C., Verma, H., Tocchetti, A., Brambilla, M., & Bozzon, A. (2024). Policy Sandboxing: Empathy As An Enabler Towards Inclusive Policy-Making. *Proceedings of the ACM on Human-Computer Interaction*, *8*(CSCW2), Article 369. https://doi.org/10.1145/3686908

**Important note**
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

**Copyright**
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

**Takedown policy**
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

*This work is downloaded from Delft University of Technology.*
*For technical reasons the number of authors shown on this cover page is limited to a maximum of 10.*

# Policy Sandboxing: Empathy As An Enabler Towards Inclusive Policy-Making

ANDREA MAURI, Université Claude Bernard Lyon 1, France
YEN-CHIA HSU, University of Amsterdam, Netherlands
HIMANSHU VERMA, Delft University of Technology, Netherlands
ANDREA TOCCHETTI, Politecnico di Milano, Italy
MARCO BRAMBILLA, Politecnico di Milano, Italy
ALESSANDRO BOZZON, Delft University of Technology, Netherlands

Digitally-supported participatory methods are often used in policy-making to develop inclusive policies by collecting and integrating citizen's opinions. However, these methods fail to capture the complexity and nuances in citizen's needs, i.e., citizens are generally unaware of other's needs, perspectives, and experiences. Consequently, policies developed with this underlying gap tend to overlook the alignment of multistakeholder perspectives, and design policies based on the optimization of high-level demographic features. In our contribution, we propose a method to enable citizens understand other's perspectives and calibrate their positions. First, we collected requirements and design principles to develop our approach by involving stakeholders and experts in policymaking in a series of workshops. Then, we conducted a crowdsourcing study with 420 participants to compare the effect of different text and images, on people's initial and final motivations and their willingness to change opinions. We observed that both influence participant's opinion change, however, the effect is more pronounced for textual modality. Finally, we discuss overarching implications of designing with empathy to mediate alignment of citizen's perspectives.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; *Web-based interaction*; **User studies**.

Additional Key Words and Phrases: Policy Sandboxing, Participatory Policy-making, Inclusive Policies, Empathy

**ACM Reference Format:**
Andrea Mauri, Yen-Chia Hsu, Himanshu Verma, Andrea Tocchetti, Marco Brambilla, and Alessandro Bozzon. 2024. Policy Sandboxing: Empathy As An Enabler Towards Inclusive Policy-Making. *Proc. ACM Hum.-Comput. Interact.* 8, CSCW2, Article 369 (November 2024), 42 pages. https://doi.org/10.1145/3686908

## 1 Introduction

When designing participatory solutions to societal problems in policy-making – i.e., wicked problems such as climate change and healthcare – it is crucial to have a complete and nuanced understanding of citizen needs and how the solution will affect them, as people may have different perspectives and concerns on the same issue [23, 111].

Authors' Contact Information: Andrea Mauri, andrea.mauri@univ-lyon1.fr, Université Claude Bernard Lyon 1, Lyon, France; Yen-Chia Hsu, y.c.hsu@uva.nl, University of Amsterdam, Amsterdam, Netherlands; Himanshu Verma, H.Verma@tudelft.nl, Delft University of Technology, Delft, Netherlands; Andrea Tocchetti, andrea.tocchetti@polimi.it, Politecnico di Milano, Milan, Italy; Marco Brambilla, marco.brambilla@polimi.it, Politecnico di Milano, Milan, Italy; Alessandro Bozzon, A.Bozzon@tudelft.nl, Delft University of Technology, Delft, Netherlands.

This work is licensed under a Creative Commons Attribution-ShareAlike International 4.0 License.

© 2024 Copyright held by the owner/author(s).
ACM 2573-0142/2024/11-ART369
https://doi.org/10.1145/3686908

However, current approaches to participatory policy-making often leave citizens unaware of other people's perspectives, circumstances, constraints, needs and experiences. This does not allow citizens to adjust their own perspectives and positions in response to the experiences of others, and leads to biased solutions [50]. Consequently, it is difficult to achieve broad acceptance of a policy decision because people with different opinions may not understand why it was made [75]. Conventional tools such as surveys and questionnaires are widely used by policymakers to capture citizens' perspectives, needs, opinions and concerns about policies. In addition, technological solutions powered by artificial intelligence (AI) and the Internet of Things (IoT) hold promise for enabling policymakers to access and make sense of vast amounts of data about the communities for whom policies are intended [22, 49, 69]. The data resulting from these approaches have been observed to favor decision makers rather than a balanced consideration of the needs of diverse stakeholders, which in turn can contribute to non-inclusive policies and a lack of trust among citizens [18, 67]. Furthermore, these solutions are mainly used to optimize policies using "*one-size-fits-all*" means, where quantitative metrics such as efficiency [66], environmental and economic indicators [12], or criminality [76, 109] are prioritized while overlooking the subjective experiences and concerns of citizens. For example, policies designed to limit the spread of a pandemic would resort to complete lockdown, with devastating effects on citizens' well-being and economic prospects [10, 110].

To address the aforementioned issues of citizen participation and the consolidation of citizens' nuanced needs and concerns in informing policymaking, past research within the social and political sciences has extensively investigated the role of deliberative democracy and participatory policymaking. It entails facilitating broad engagement in policy discourses aimed at consolidating local knowledge and diverse opinions to inform inclusive policies (e.g., [37, 61, 65, 91]). This scholarship has manifested itself in the development of tools, such as DemocracyOS[1] and ConsiderIt[2], that enable broader citizen participation and engagement in policymaking. These platforms have since been adopted by various communities and elected bodies and integrated into participatory democracy processes. Such platforms, including some social media platforms, have been observed to be advantageous in *(a)* supporting "constructive rather than confrontational discourse" [62], *(b)* persuading large-scale engagement on policy issues through voting and sharing of perspectives, concerns and needs [40, 102, 113], *(c)* facilitating awareness and analysis of diverse perspectives and opinions [17, 40, 41, 62, 120], and *(d)* promote critical consciousness and action (especially among youth) on socio-political issues [17]. Moreover, recent research has also examined the communicative ecologies of politicians and how policymakers of different ideologies and partisan affiliations collaborate on legislative matters [117].

Although the existing research on participatory policy-making has predominantly sought to support discursive aspects at scale, i.e., by eliciting the diverse opinions, concerns, and experiences of general populace. Still, there is little evidence for the use of participatory policy-making platforms to **collectively test and adjust policies with the intended communities before they are implemented**, and provide policy-makers with a nuanced understanding of policies' impact on different social strata [100]. Our work extends the research on participatory policy-making platforms and practices, exemplifying means of collectively yet rapidly "sandboxing" new policies and modifying them based on community feedback, while mitigating opposing (or rather conflicting) positions within different factions of the community. Specifically, we examine how exposing citizens to the experiences, concerns, perspectives, and perceptions of others regarding a policy proposal can facilitate their ability to find common ground and adjust their respective positions, while providing policymakers with nuanced insights into citizens' evolving public perceptions of that

[1]DemocracyOS: https://democraciaos.org/en/ (last visited on 22/04/2024).
[2]ConsiderIt: https://consider.it (last visited on 22/04/2024).

policy proposal. This thesis is supported by recent empirical evidence, which, although lacking consensus, highlights the role of empathy–expressed across affective and cognitive dimensions–in political discourses, especially in making citizens aware of other people's positions and opinions, which may be similar or opposite to their own. Muradova and Arceneaux [78] observed that in a politically polarized environment, actively considering the perspectives and feelings of others, especially in disagreement, enables attitudinal change and promotes critical reflection on political issues. In addition, Vanman [114] found in his systematic review that although people often empathize with others with similar perspectives and characteristics, explicit awareness of others' opposing perspectives also leads to reduced prejudice. However, Klimecki et al. [60] observed that the effect of empathy on sensitive political issues, such as immigration, is not homogeneous across people with differing partisan associations or political beliefs. In this way, we aspire to *(a) enable* policy-makers to test new policies before implementing them, *(b) capture* a nuanced and detailed understanding of how each policy is likely to affect different members of society and how perceptions evolve before and after citizens are exposed to opposing positions, and *(c) visualize* the differential perceived impacts of policy proposals on different subgroups and how they can enable citizens to meaningfully negotiate and adjust their respective positions and opinions with respect to the proposal.

We refer to this process as **policy sandboxing**, deriving it from the notion of "sandboxing" from computer science [87], where software components are isolated with limited system resources and tested so as to mitigate or prevent likelihood of risks and failures. Unlike **regulatory sandboxes** [4, 5], which are defined as "regulatory tools allowing businesses to test and experiment with new and innovative products, services or businesses under supervision of a regulator for a limited period of time" [71, p.2], policy sandboxes refer to tools or services that enable participatory engagement *at scale* of policy-makers and citizens to collectively, yet rapidly, test and adapt new policies at varying scales and levels of governance. Policy sandboxes do not enforce the presence of the regulatory entity, as their purpose is to enable the collection of a nuanced understanding of citizens' needs and concerns, provide opportunities for citizens to develop a better awareness of others' needs and experiences, affording a means to adjust one's own position in response to the exposed position of others, and subsequently foster the development of policies that meaningfully address their diverse concerns.

In this article, we contribute by exemplifying the realization of policy sandboxing by presenting and evaluating a web-based tool that allows policymakers to make policy proposals and invites citizens to express their initial positions and perspectives in response to the proposed policy. Subsequently, citizens are exposed to the diverse – and often contrasting – ways in which the policy proposal affects others, and are asked to reconsider their previous positions[3]. In this way, we also empower policymakers to improve their policy proposals through participatory engagement with affected communities, soliciting the evolving perspectives and positions of citizens. The rationale for exposing citizens to the different ways in which the same policy affects various subgroups is supported by previous work on online deliberation platforms, in particular [6, 39, 62, 84], which has shown that shared awareness of others' concerns and positions – especially on sensitive social issues – provides opportunities to develop deeper understanding and grounds for negotiating one's own position. We also believe that in this way it can potentially lead to greater policy acceptance by citizens.

We present the co-design of the aforementioned web-based policy sandboxing tool with relevant stakeholders. Moreover, we are also interested in understanding how citizens can be exposed to the

[3]Thorough the paper we will use the terms *perspective*, *stance*, *position*, and *opinion* interchangeably with the meaning "the attitude of a person towards an argument".

perspectives and positions of others, potentially leading them to negotiate their initial opinions and positions on a particular policy proposal. While it is known that combining different media, such as images and text, helps to convey a richer set of information [118] and may contribute to the ability to understand the perspective of others [21, 86], it is unclear how it can be leveraged to mitigate potential conflicting positions within a community. Therefore, through a crowdsourced online study, we investigate whether different modalities, either textual or pictorial, or a combination of both, used to (re)present the divergent and contrasting opinions and positions of others affect changes in one's own stance following this exposure.

It is worth noting that we don't aim to replace existing practices of policy discourse and deliberation, and we don't claim that our approach replaces the testing of a policy through its implementation. Instead, we envision our tool –or its design principles– as complementary to the policymaking and testing process, regardless of how and where it takes place.

In the remainder of this article, we situate our work within the existing literature, framing the research gap in Section 2. Next, we present the co-design of the policy sandboxing tool in Section 3, followed by the crowdsourcing study in Section 4. The analysis of our experiment and the results are presented in Section 5, while in Section 6 we draw the implications of our research and discuss them in relation to previous literature, followed by the conclusion in Section 7.

## 2 Related Work

In this section, we discuss works related to online deliberation and how it can be supported by (Web) technology. In particular, we start presenting works from both social/political science and HCI discussing how to design online deliberation, then we move to existing deliberation platforms. Finally, we focus on works more directly related to ours that support and promote deliberation either by making people reflect on others' opinions or, in general, by nudging/priming them into less polarized views.

### 2.1 Design Principles Underlying Online Deliberation

Research on online deliberation dates back to the beginning of Web 2.0. As soon as platforms such as public online forums gave voice to the public, researchers started to investigate how they could be used to promote online deliberation. Karlsson [52] analyzed different online forums to understand which characteristics of the platforms contribute to successful deliberation, identifying factors such as number of participants, diversity of starting opinions, and level of engagement. Similar considerations are drawn by Towne at al. [111].

Coleman et al. [19] – with a more top-down approach – elaborated on what is the role of online deliberation in the democratic process and argued that to enhance it (and not replace it), the deliberation should stop looking to achieve consensus at all cost. Similarly, Wright [119] argues that researchers should stop trying to mimic political deliberation in online platforms, but focus on the design of specific tools, because – on the Web – the discussion happens on unofficial channels (i.e., spontaneous discussions on online forums).

Friess et al. [34] provide a framework to analyze online deliberation based on the design of the deliberation, the quality of the communication, and the expected result. An interesting outcome of their systematic review is the recommendation to keep the communication asynchronous, to give time to the participants to reflect and motivate their contribution.

More recently, researchers have also explored ways to promote engagement in deliberative contexts. For instance, Hassan et al. [47] investigated how gamification elements can be included in the deliberation process. They argue that, while gamification can be used to make more accessible the deliberation process, it can exclude part of the population that is not technologically savvy or

interested in the deliberation. Kwak et al. [64] investigated the effect of persuasion in the deliberation process, specifically how it can make people more engaged in deliberation. Interestingly, they found persuasion can hinder the deliberation process if people are exposed to information too far from their point of view, but that it can beneficial to it if such exposure is more modest.

The HCI community [81] focused on how technology can contribute to participation, investigating the collaboration between HCI and political science, in terms of empirical, conceptual, and constructive works (i.e, studying and developing systems, see the following Section 2.3 for more works relevant to ours). Palacin et al. [85] discuss the concept of pseudo-participation – i.e., when peoples' choices are limited – arguing that identifying those types of participation is a first step towards proper empowerment of the citizen.

In the latest years, people have investigated how to extend this deliberation process in specific environments [1]. Interesting is the work of Biedermann et al. [13], where they experiment on how technology can improve deliberation by shifting the control of the process to the citizen.

### 2.2 Deliberation Platforms

While our work is not meant to be a deliberation platform – but an approach that can be applied within an existing deliberation process or platform – we share with this line of research the belief that adequately designed technology can give voice to the people regarding important aspects of society.

One of the first examples of an online deliberation system is Deliberatorium [59], an argumentation system to enable large-scale deliberation. The idea is to structure the discussion in an argument map having issues, ideas (to solve those issues), and argumentation (to support the ideas). Users cannot change an argument, but can only create new ones to support (or contrast) other people's ideas.

In the same years, e-Liberate [97] was developed, designed by following the *Robert's Rules of Order* principle (i.e., a set of guidelines designed for parliamentary procedure ) [44]. The tool was developed before web technologies became pervasive in our everyday life, and it was not designed to be used by everyone, as it required to be familiar with Robert's Rules. In this way, the tool imposed strong control over the deliberation process, requiring an individual to chair the deliberation session. However, it is important to recognize that the e-Liberate system has proposed several design guidelines that are still relevant today. First, online deliberation systems should avoid facilitating the collaboration process that focuses on only the content of the messages. Second, such systems should also avoid imposing a top-down protocol to control the collaborative process and remove agency from the people.

Furthermore, a significant amount of research in recent years has attempted to investigate how online platforms can foster constructive discussion on issues related to societal challenges. Net Democracy Foundation[4], a not-for-profit organization, launched an open-source web-based platform called "DemocracyOS[5]" in 2012 to enable dialogue between citizens and policy makers that extends beyond the periodic voting [72]. Moreover, aiming to foster citizen collaboration and public deliberation on aspects related to policy-making, another web-based platform called "ConsiderIt[6]" allows for elicitation of people's opinions and perspectives, and encourages consideration of trade-offs by supporting or opposing shared proposals [62, 101]. They present an important underlying design philosophy to encourage and enable participants to reflect on views that disagree with them. The design intends to promote persuasive points while encouraging diverse views.

[4]Net Democracy Foundation (Democracia en red): https://democraciaenred.org (last visited on 24/04/2024).
[5]DemocracyOS: https://democraciaos.org/en/ (last visited on 24/04/2024).
[6]ConsiderIt: https://consider.it (last visited on 24/04/20243).

DebateHub [88] is a collaborative platform aiming at increasing the quality of online debate based on argumentation. It does so by promoting reflection and reducing echo chambers and homophilic thinking by utilizing different visualizations to show peoples' perspectives. They found that visualization helps user experience, in terms of mutual understanding.

LiquidFeedback [9] is a platform based on the concept of LiquidDemocracy [51]. It allows complex decision-making by mixing elements of direct and representative democracy, with a special focus on giving voice to minorities by using different weighting mechanisms.

Based on DebateHub [88] and LiquidFeedback [9], Verdiesen et al. [116] developed MOOD, a deliberation platform focusing on differentiating and validating facts and opinions, and mapping both the social acceptance and the moral acceptability of debate outcomes. Another example is Decidim, an online deliberation platform that supports users' dialog with discussion threads and comment labeling (neutral, positive, negative) [6]. Decidim hypothesizes that combining conversation threading and comment alignment should promote cognitive dissonance in users, leading to a higher willingness to discuss the proposals and, thus, to deliberative practices of decision-making. Both of these online deliberation systems are based on the idea that by making people reflect on others' perspectives, for example, through discussion or using social media mechanics (e.g., likes, dislikes, and comments), it is possible to promote a more democratic decision process. Similarly, in [68], the authors investigate how an interactive visualization—affects group consensus. By changing how people see others' decisions of a topic the authors found it is extremely beneficial to highlight where disagreement occurs and to show the arguments of both side.

Another example is the California Report Card [2], a mobile application that allows citizens to inform the state of California about important issues that need to be discussed. Participants can both propose new ideas and vote on existing ones. The participants see the suggestions on a two-dimensional space [31] and can vote on the ideas on two dimensions - how important it is and how good are the current solutions. Interestingly, they found that once the median score for a specific suggestion is shown, participants tend to move towards it in their decisions.

### 2.3 Enhancing Deliberation though Technological Means

Several tools have been developed to improve deliberation processes, by either making people reflect on others' opinions and points of view, inviting people to participate, or persuading them to take a less polarized stance. Typically, these works investigate how different ways of presenting and interacting with people's opinions (or different stances about a topic) change how they reflect on them and ultimately how they lead to opinion change.

OpinionSpace [31] is a user interface where users can navigate others' comments about a topic in a 2d map based on their stance on the topic, In their findings, the authors report that with this type of interaction, users felt more engaged, agreed with, and respected other points of view.

In their research, Gao et al. [36] experimented with a recommender system that alternatively suggested articles agreeing and disagreeing with the opinion of the user. By alternating the articles, the authors aim at sparking the curiosity of the users. In the end, this system was able to make people aware of their own stances and made them more willing to read more articles.

Gao et al. [8], explored how natural language processing techniques can be applied to promote critical thinking by highlighting the connection between different articles presenting different political views. In this way, the users broadened their exposure by seeing articles from sources they would never inspect otherwise, by making them read about new topics, and by showing different perspectives.

A more interactive approach was proposed by Kriplean et al. [63], where the authors propose a web tool that allows readers to write short bullet points summarizing a comment/post on the Web

written by an author. The author can then review the bullet points and verify that his message was understood correctly. This system allows from one side the reader to reflect on what the author wrote, and on the other side the author feels he is being "listened to".

In a similar fashion, but in the context of social networks, Garrido et al. [42] propose a recommender system to make users explore profiles of people having different political views than their own. The system makes use of data portraits - i.e., user portraits built with data published by them. They show that, while the homophilic behavior - i.e., in this case, the tendency to follow a profile similar to you - did not disappear when the recommender system recommended non-diverse profiles, it however increased users' exploration of the different profiles.

Another example is DebateBot [57], a conversational agent designed to structure the discussion and ping participants who do not contribute. This work showed the positive impact of chatbot-moderated discussions on the quality of group conversations. Encouraging less active participants to engage, it promoted opinion alignment, equal contribution levels, and higher overall satisfaction among group members.

Yeo at al., [120] investigated how to use LLM to generate different types of reflective textual nudges finding that persona-oriented ones can generate a more deliberative environment. Similarly, Gover et al. [41], used a bot to implement different conflict resolution strategies [107], finding that cooperative strategies work better than forceful ones.

However, some works also highlight that simply showing diverse opinions is not enough [77], but that a systems needs to be designed with the objective of make people reflect [96].

Previous works in persuasive design have investigated how user interface elements can influence people's behavior [33, 82]. Also, there exist strategies that rely on implicit elements of the user interface to trigger attitude change without the conscious participation of the user [38]. Generally, these methods are based on the concepts of priming [53], nudging theory [103], and self-reflection [58].

For instance, Seering at al. [98] designed user interface elements to improve the quality and civility of discourse in online commenting behaviors. In particular, they used hand-crafted captcha to prime users' positive emotions and mindset. Similarly, in relation to harassment on social media, Royen et al. [92] explored how the user experience could be designed to change user behavior by employing a reflective interface. The interface notifies the users of the harmful nature of their comments, makes users reflect on the comments, and asks users to reconsider sharing them.

### 2.4 Summary

Deliberation platforms, are currently designed to replicate deliberation processes [51, 91] - consisting in proposing a topic, voting and achieving consensus - and highlight that it is extremely beneficial to allow citizens to reflect and discuss each other perspectives.

These works inspired our design, both in term of how the online deliberation process should be and the characteristics the system should have. They also highlight interesting gaps. As mentioned in the Introduction, it's not clear how these type of digital platforms can be designed and used to test and adjust policies. Second, reflective interfaces typically either provide an overall view of people opinions or shows their preferences in term of votes or text - while, persuasive design works shown the power of visual cues to change people's perspectives. Thus, it's not clear in this context if and to what extent combining different media could be used to achieve a more inclusive deliberation process

## 3 Human-Centered Design of the policy-sandboxing tool

In this section, we describe the participatory processes that led to the first design of the system employed in the rest of the study. Specifically, the design of the tool – a gamified web application

promoting citizen engagement and co-creation in public decision-making – underwent three different design steps.

### 3.1 Initial System Design

We borrowed the initial design of the tool from Tocchetti et al. [108] since they developed a framework through which community members can express their opinions and thoughts about a topic in a co-design fashion. Interestingly, their focus is to enable crowdsourcing and co-design campaigns to move from traditional, short-term objectives to long-term visionary ones typical of policymaking, such as societal and economic changes. Intentions that align with the ones belonging to the idea of policy sandboxing.

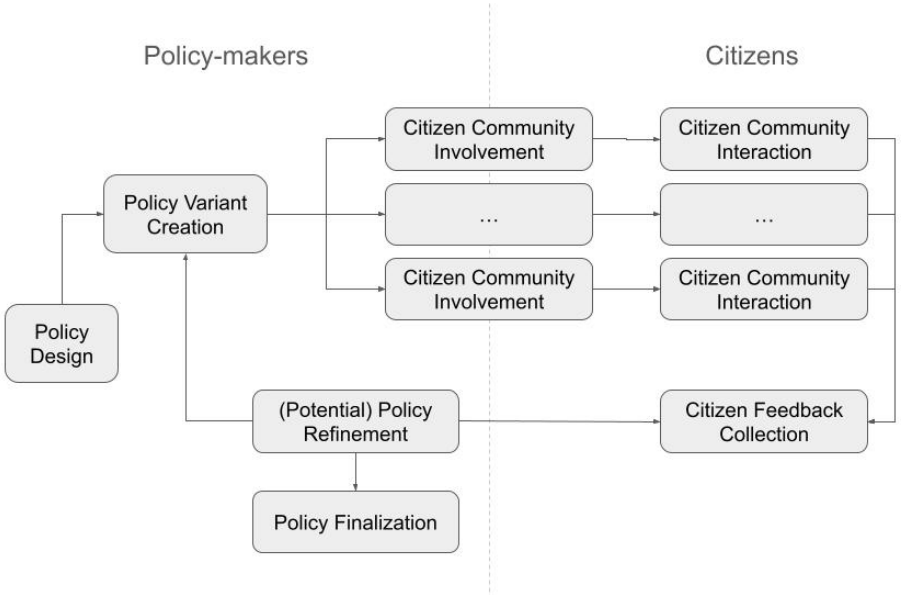



Fig. 1. A schematic representation of the process presented by Tocchetti et al. [108] to engage citizen communities in shaping and refining policies.

In particular, their tool involves a series of steps through which a policy is shaped, refined, and finalised into a concrete policy to be applied. The process (represented in Figure 1) involves several steps.

- The policy-maker designs a new policy to test before its implementation.
- The policy-maker creates various variants that could be applied to different citizen communities.
- One or more citizen communities are engaged and presented with the proposed policy variations.
- Citizens interact with each other through the gamified activities available on the platform, sharing their thoughts on the policies they are presented with.
- The citizens' feedback and thoughts are collected and analysed.
- The policy is refined using the collected feedback. Then, the policy-maker decides to refine further or finalise the policy.

In their paper, they performed two workshops with policy-making experts and citizens to evaluate the applicability of the *wisdom of the crowd* to support the policy-making process. The main elements highlighted during their workshop which strongly inspired our design are the following.

**Engagement and Gamification**. In order to maintain the interest and active participation of citizens and domain experts, it is crucial to design engaging activities. One widely utilized method for achieving this is Gamification, which aims to enhance people's motivation towards various tasks by incorporating game elements and design techniques[94]. By focusing on intrinsic motivation, which revolves around self-improvement, can lead to a sense of engagement resulting in sustained commitment. Conversely, extrinsic motivation is employed to initially stimulate engagement and incentivize individuals through tangible rewards or outcomes. In the context of public engagement, we have explored different gamified approaches and their impact, as detailed in studies such as [11, 26, 46, 104–106, 115].

**Community**. One of the primary objectives of a policy sandboxing tool should be to develop a proactive community of citizens and domain experts. To achieve this, it is crucial to prioritize collaborative and interactive activities. By fostering a sense of unity within the community, the overall quality of user-generated content can be significantly enhanced, along with their dedication towards common objectives [45]. Notably, the inherent psychological need for connection and belonging, known as relatedness, has been identified as one of the fundamental motivating factors [94].

**Empathy**. A policy sandboxing tool should leverage empathy to engage users. We expect citizens to empathize with the thoughts shared by others to expand their opinions on the subject of discussion. This principle influences the design of most activities on the platform by establishing emotions as one of the most relevant elements to engage citizens.

The insights gathered from the experiment served as the foundation for designing and implementing the first version of the web-based application [108]. Subsequently, the application was tested in the second workshop involving groups of citizens in discussions on topics defined by policymakers, thus evaluating the final outcome of the design process.

In conclusion, the presented tool [108] is strongly aligned with policy sandboxing as it enables policy-makers to collect citizens' reactions by exposing (selected) communities of citizens *(b, c)* to policies *(a)*, consequently shaping them based on people's reactions *(c)*, finally developing a policy proposal achieving common consent.

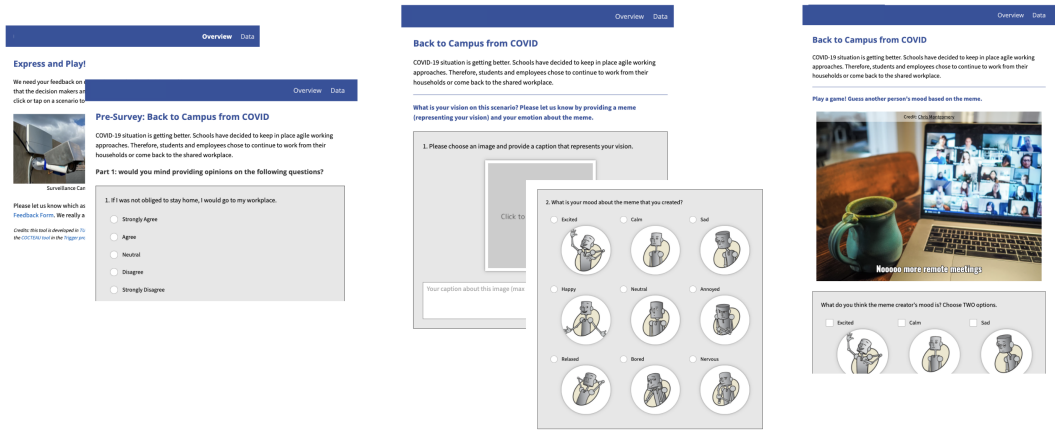
### 3.2 Current Design of the system

The system design was inspired by the framework developed by Tocchetti and Brambilla [108], which combines crowdsourcing and data science to enhance citizen engagement and contribution to policy making. In addition, we embodied the principles of the ContextMapping design method [118] to facilitate citizen engagement. The latter was chosen because it is a participatory method that considers fostering empathy among diverse stakeholders by engaging them in generative sessions and discussions where they create artifacts describing their point of view.

As consequence, the system's current design incorporates gamified activities that enable citizens to express their thoughts and emotions regarding a particular topic using pictures, keywords, and text. Through these gamified activities, citizens are encouraged to exchange opinions. Policymakers introduce the topics to be discussed on the platform, aiming to gather user perspectives and sentiments. The collected data is then analyzed and presented as aggregated information to policymakers, ultimately contributing to the decision-making process on relevant subjects.

Notably, our tool facilitates structured and simplified communication between local communities and policymakers, introducing innovation to the conventional citizen engagement process and reducing the effort required from both sides.

Figure 2 shows how the users are guided in sharing their opinion as a combination of an image, a textual description, and an emotion (a concept called *vision*). The process is composed of the following steps:




(a) (b) (c)

Fig. 2. Three main parts of our tool: (a) sensitivation with a survey, (b) content creation, and (c) content guessing.

**Sensitization**. Figure 2(a) shows the first step where users are presented with a survey. In this survey, they are requested to evaluate a series of statements using a 5-point Likert scale, ranging from *strongly disagree* to *strongly agree*. This phase serves two purposes: first, it allows us to gather the user's initial opinion, and second, it prompts them to reflect on the topic at hand. This is a direct mapping to the first phase of the ContextMapping method [118].

**Content Creation**. In this step, shown in Figure 2(b), users are engaged in generating *visions*, a digital artifact composed of an image, a textual description, and a mood. To facilitate image selection, we utilize the Unsplash API[7], which allows users to perform keyword-based searches within a dataset of images. The selection of a mood is facilitated through the Pick-A-Mood toolkit, a validated tool in previous studies that employs character-based pictorial scales for reporting and expressing moods [28]. This step allows users to shape their opinions using a more empathy-oriented approach, conveying their thoughts through a combination of text and pictures rather than text only. This is a way to recreate a digital version of the generative sessions in ContextMapping [118]. The idea is that in this way we can tap into peoples' thoughts, feelings, and ideas.

**Guessing Game**. The final phase, shown in Figure 2(c), involves users participating in a game where they attempt to guess the mood associated with a vision created by another user. This step serves the purpose of, firstly, fostering a sense of empathy among users as they strive to comprehend each other's visions; and, secondly, enhancing user engagement through interactive gamified elements. This step is greatly inspired by the discussion phase in ContextMapping [118], and by the various works on reflective interfaces previously described in Section 2. We decided to design it as a game (instead of a full discussion session) because we wanted a faster interaction that could happen ideally in a serendipitous way.

[7]Link to the Unsplash API – https://unsplash.com/developers

*3.2.1 Implementation.* The implementation of the platform can be found on GitHub, made available under the MIT license[8]. The README file in the documentation provides detailed information about the techniques and packages utilized in building the platform, which is divided into two main components: the front-end web client and the back-end server. The front-end is developed using HTML, CSS, JavaScript, and the jQuery library[9]. On the other hand, the back-end is constructed using Python, leveraging the Flask web framework[10] and the PostgreSQL database[11]. Deployment of the platform is achieved using uWSGI[12] in conjunction with an Apache Web server[13]. The GitHub repository also contains further details and instructions on how to access and utilize the platform.

*3.2.2 Preliminary Evaluation.* To evaluate how the tool could be used to facilitate brainstorming on different societal challenges, we performed a small study adopting an ethnographic observation approach. The observations revealed that students had no difficulties using the tool to submit their answers. About 50% of students used the tool during initial discussions, but usage dropped to 20% during group brainstorming. Notably, students using pen and paper tended to keep the tool open more than those using digital whiteboards. The study highlighted the need for better integration of the tool into existing brainstorming processes and suggested further research to enhance support throughout the entire brainstorming session. More details about the study are reported in Appendix A

## 4 Crowdsourcing Empirical Study

The design phase in the previous section focused on determining the main features of a tool to enable policy-sandboxing, as well as studying its feasibility and limitations. The next phase focuses on understanding how we can use our approach to allow policy-makers to design more inclusive policies.

We investigated how the modality of showing other people motivation about a choice may influence their stance about a topic. The ideas is to allow people to reach a consensus on a policy that could be less beneficial for the single but more inclusive for the community as a whole. To do so, we investigates the effect of showing other people's motivations with textual and visual elements in decision-making. The effectiveness of combining different types of media (e.g., image and text) for conveying information is well known in user-centered design approaches. For example, designers organize workshops and ask participants to describe their experiences regarding a phenomenon by creating physical artifacts such as pictures and newspaper cut-outs [118]. However, it is unclear how different forms of presenting information influence people's attitudes in opinion changes.

This study focuses on two aspects, which correspond to two analysis pipelines (discussed later in section 4.4). First, does presenting other people's choices and motivations using different modalities (text and image) influence the decisions to change opinions? Previous work [62] has investigated the effect of showing other people's choices and opinions. Also, previous works in design and digital-mediated empathy have highlighted how images can convey richer meaning [21, 86], allowing people to express their perspectives more profoundly [118]. Thus, we hypothesize that showing other people's motivations (compared to not showing them) plays a crucial role in attitude changes. We also hypothesize that using a richer depiction of the motivations can lead to more changes in opinions and make people with extreme opinions shift theirs to a neutral one.

[8]Link to our code – https://github.com/TUD-KInD/COCTEAU-TUD
[9]Link to the jQuery framework – https://jquery.com
[10]Link to the Python Flask package – https://flask.palletsprojects.com/en/2.0.x/
[11]Link to PostgreSQL – https://www.postgresql.org/
[12]Link to the uWSGI tool – https://uwsgi-docs.readthedocs.io/en/latest/
[13]Link to the Apache web server – https://www.apache.org

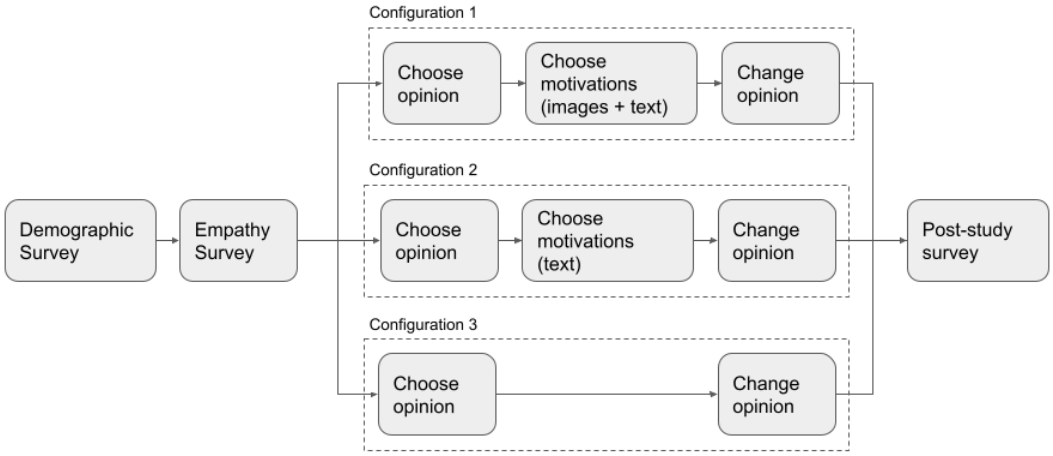



Fig. 3. This figure shows the research procedure. Participants are first presented with survey questions that collect demographic information and measure empathy levels. Next, there are three configurations with different presentation forms regarding people's motivations for a hypothetical scenario (Figure 1). All configurations ask people to choose their opinions and later revise the opinions with pre-defined votes (Figure 5). Configuration 1 shows motivations using both image and text (as shown in Figure 4.a). On the other hand, configuration 2 uses only text for the motivations (as shown in Figure 4.b). Configuration 3 serves as the control condition that does not display people's motivations. Finally, there is a post-study survey that collects user feedback about the study.

Secondly, we are interested in exploring factors that may be related to opinion changes. For example, previous works in psychology suggested that people's empathy may affect their decisions [35, 79, 89, 90, 93], which could be reflected in the number of selected motivations that they agree with the others. Also, we would like to inspect whether different behaviors of choosing motivations are linked to opinion change or the final decision. Particularly, we are curious about the dynamics and behaviors around the most balanced opinion compared to other more extreme ones, as the findings could offer insights into designing interaction modalities that can lead to inclusive solutions.

### 4.1 Procedure

We designed and performed a controlled experiment on Prolific[14], a crowdsourcing platform specifically for researchers to conduct large-scale user studies. The experiment is a between-subject study where different users participate in three different system configurations following a predefined research procedure (Figure 3). In the study, participants are asked to choose their opinions in a hypothetical scenario, presented with different forms of other people's motivations for their opinions, and then asked if they would change their opinions. There are pre-surveys (before the experiment) and a post-study survey (after the experiment). The experiment is anonymous and does not collect personal identifiers. This section explains the procedure, which is approved by the Human Research Ethics Committee at our institution. Materials (e.g., surverys) are described in the next section.

Figure 3 illustrate the experiment procedure. We use a modified version of our tool shown in the previous section. Also, since the user-contributed data involve political opinions, which can

[14] https://www.prolific.co

Table 1. Description of the Hypothetical Scenario in the Study

| **Back to Campus from COVID** |
| --- |
| The COVID-19 situation is still full of uncertainties. Even with vaccinations and other measures, the growth of the number of cases is not slowing down enough. Universities have decided to keep in place agile working approaches. While suggesting work and study from home as much as possible, they allow people to return to the shared workplace. However, facility managers and people responsible for on-campus activities need to define working policies that both satisfy people's needs and government guidelines. To do so, they asked people working and studying on campus to express their opinion on this matter. |

Table 2. Description of the Available Opinions

| Code | Description |
| --- | --- |
| O1 | The university should not allow people to work on campus, and all activities should be online. |
| O2 | The university should only allow fully vaccinated people to enter the campus. |
| O3 | The university should support the hybrid setting to enable both physical and virtual presence (for example, using scheduling systems or masks). |
| O4 | The university should only allow education activities on campus, and no other activities are allowed (e.g., social gatherings). |
| O5 | The university should allow people to work on campus without restrictions. |

potentially be sensitive, using our own tool enables us to store and manage all user data on the server in our institution without relying on third-party web-based software.

At the beginning of the study, the web interface displays an informed consent form. Only those who provide consent can proceed to the study. After the informed consent, participants fill out two pre-surveys that asks demographic information and measure empathy levels.

Next, we present a hypothetical scenario (Table 1), which is related to the debate regarding student activities in universities during COVID. We decided to use the scenario since it matches the social context at the time when we conducted this research, where organizations were dedicated to understanding how to implement policies related to the COVID pandemic. For instance, in the case of regulation of the work and study conditions after COVID, students may miss the in-presence lectures as they allow them to socialize with their peers; some teachers may prefer giving lectures physically, as it facilitates the engagement with the students. On the other hand, some people may have become used to online lectures and remote work since they realized they could have a better work-life balance.

Besides the scenario, participants are evenly assigned a random stakeholder role (bachelor student, master's student, Ph.D. student, researcher, and professor), each with different descriptions of the roles (Appendix F). Participants are also asked to choose an opinion (Table 2 and Figure 5.a)

representing their stance on the scenario. Moreover, to be consistent with the next step of selecting motivations, the tool asks the participants to create a motivation (by choosing an image and writing a few words) that explains why they choose the opinion. We explicitly remind people that the text can be creative with the choice of the image and the text, and the text should not merely describe the image.

Then, depending on the system configuration, participants are either asked to select motivations (i.e., configurations 1 and 2 in Figure 3) or not (i.e., configuration 3). We specifically explain that participants should select the ones that resonate with their perspectives or make them understand other people's points of view. Each opinion has eight motivations (Figure 4 and Appendix G), either presented with both text and image (i.e., configuration 1) or with only text (i.e., configuration 2). Participants need to go through all the motivations for all opinions (even those that they did not choose) in these two configurations. The motivations and opinions are created by reseachers, and their order is randomized when being shown to the users.

Finally, participants are presented with the scenario description again and asked to revise their opinion regarding the scenario (Figure 5.b). Our tool explicitly reminds people to select their opinion again after looking at other people's motivations for choosing opinions in the previous step. At the step, the interface also shows hypothetical votes for each opinion, which is designed to keep the control condition (i.e., configuration 3) consistent with all other configurations. Afterward, participants fill out a post-study survey.

### 4.2 Materials

*4.2.1 Informed Consent and Pre-surveys.* The informed consent form can be found in Appendix B. The pre-surveys asks demographic information (Appendix C) and measure empathy levels (Appendix D). Demographic questions include gender identity, age range, and education level. Empathy questions are adapted from the Perspective Taking and Empathic Concern items in the Interpersonal Reactivity Index questionnaire [24, 25]. Perspective Taking means the ability to step outside the self to change perspectives when dealing with other individuals, while Empathic Concern indicates the degree to which the participant experiences feelings of concern for others. Each empathy question can be answered on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). We tweaked some words to make the question gender-neutral For example, "guy" is replaced with "person", and "his" is replaced with "their".

*4.2.2 Available Opinions and Motivations.* The available opinions and motivations are pre-defined based on the consensus of four researchers, who iteratively created a pool of diverse opinions and motivations, and merged similar ideas. We design the opinions and motivations to cover different stances to our best, specifically on a spectrum ranging from entirely restrictive (i.e., allowing no activities in universities) to completely liberal (i.e., allowing all activities in universities). Regarding opinions, each researcher first came up with a list of opinions. Then, all researchers worked together to sort the opinions based on how restrictive the COVID measure is. Similar ones were grouped together and further refined into one representative opinion. This step resulted in five opinions (see Table 2). Next, each researcher crafted several motivations for each opinion. The motivations contain text and images. Images for the motivations are obtained using the Unsplash API[15]. After crafting motivations, the researchers discussed them together to merge similar ones and select eight motivations in total. The selection criteria were based on having a diverse range of views. However, researchers are not representative of various groups of people, and in this case, we used the motivations and opinions that appeared in social debates during the COVID pandemic.

[15]Link to the Unsplash API – https://unsplash.com/developers

*4.2.3 Post-study survey.* The post-study survey (Appendix E) asks questions about user feedback and the degree to which each element of the interaction (images, text, and votes) contributed to their choice. The post-study survey also asks the participants to indicate the importance of the images, text, and votes separately using Likert scales.

*4.2.4 Quality Control.* For quality control, we employ attention checks (one instructional manipulation check and two reversed question checks) in the pre-surveys. These questions can be found in Appendix D. Also, at the step of revising opinions, we ask participants to enter "I confirm my opinion" in a text box as another instructional manipulation check.

### 4.3 Variables

We now describe the dependent variables $Y$, independent variables $X$, and confounding variables $Z$, in the context of $Y = F(X, Z)$ for analysis. We also describe control variables that remain unchanged in this study.

*4.3.1 Independent and Dependent Variables.* Our independent variable is *system configuration*, indicating if and how the motivations were shown to the participants. There are three types of system configurations. Among them, two configurations display other people's motivations after selecting the initial opinion using different presentation forms. The first form shows both text and image (similar to the meme), and the second form shows only the text part. The third configuration serves as the control condition, which does not show the motivations for choosing a specific opinion.

Our dependent variable is *change occurrence*, (true/false) that indicates whether people revise their opinions or not. If change occurrence is true, it means that the participant changed the opinion after the intervention (i.e., the system configuration).

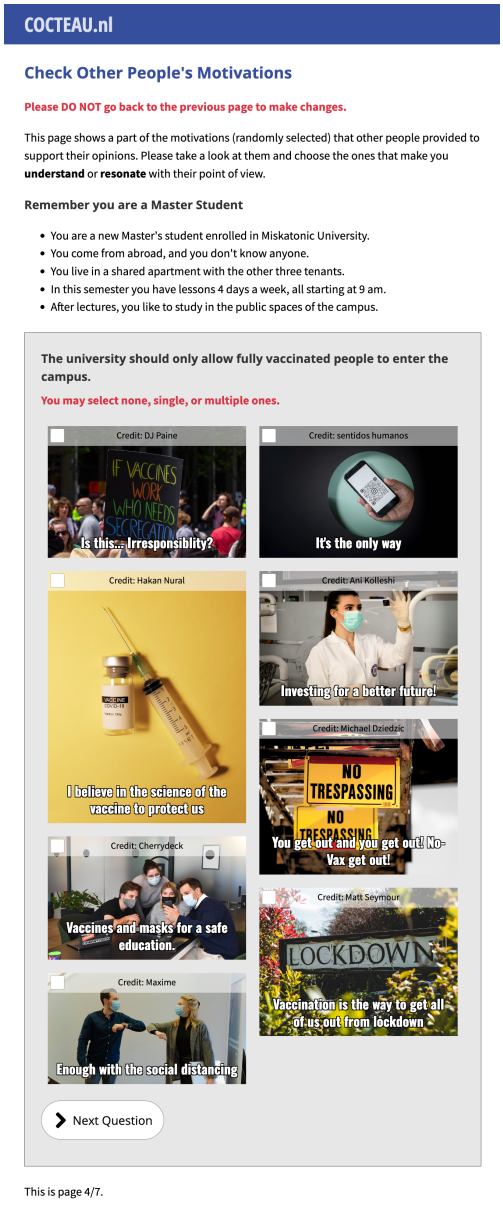
We focus on opinion change because it indicates that a participant carefully considered others' motivation - ideally moving to a less egoistic stance [30, 80]. Later in the analysis we also considered the direction of the opinion change (i.e., if the participant chose a more or less restrictive opinion). Also, the change of opinions can be seen as a facet of the *constructiveness* concept, that relates to the attempt of the deliberation process to arrive at a common ground [112].

*4.3.2 Confounding Variables.* There are two sets of confounding variables: *demographics*, *empathy levels*, and *vote importance* (whether the participants think seeing other people's votes is important in choosing opinions), which we collected in the post-study survey. Demographics include gender (male/female), education status (has a higher education degree or not), location (is in European countries or not), student status (is a student or not), job status (has a full-time job or not), and age range. The gender, location, student status, and job status information are obtained from Prolific demographics data. Empathy levels are measured using the Interpersonal Reactivity Index questionnaire [24, 25], which has the Perspective Taking and Empathic Concern items. After flipping the corresponding values correctly, depending on whether the item is a revered question, we take the mean value (Likert scale) of the empathy items as the final score for each participant.

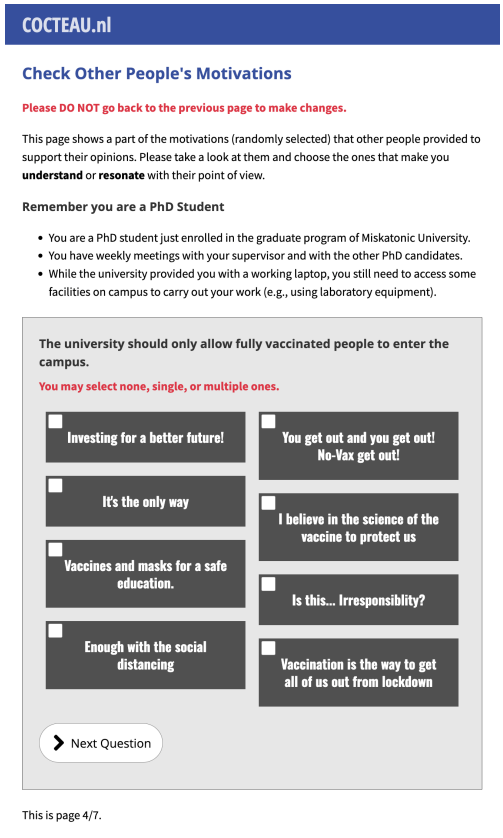
*4.3.3 Control Variables.* We decide to hold the following variables as constant: *available opinions and motivations* to choose, as well as the *votes of the opinions*. The available opinions and motivations are created by researchers before conducting the experiment. Also, we manually assign the votes for each opinion. The control of opinions, motivations, and votes ensures consistent content for each participant during the study.

### 4.4 Analysis

We conduct the following two analysis pipelines.




(a)




(b)

Fig. 4. This figure shows the user interface for system configuration 1 and 2 (i.e., those that shows motivations). Figure (a) displays motivations for a specific opinion using both image and text, while figure (b) shows the motivations using only text. We provide 8 motivations for each opinion.


Fig. 5. The left (a) and right (b) images in the above figure show the list of opinions on the user interface that participants can choose and revise, respectively. Notice that the interface for revising opinions shows the pre-assigned votes.

*4.4.1 First Analysis: Effectiveness of Showing Motivations and the Confounding Factors.* First, to determine if showing people's motivation is effective in change occurrence, we apply Fisher exact test in three contingency tables, to verify that there is statistical significance difference between the number of opinion changes among the different configurations. Each table has size 2×2, which represents a combination of two system configurations. More specifically, we use the Fisher exact test of independence to check whether the proportions of these two variables are significantly different. We compare the difference among three pairwise groups of system configurations with Bonferroni correction, which means that the adjusted significance level is 0.017 (instead of the original 0.05). Rejecting the null hypothesis suggests evidence that system configuration somehow explains change occurrence, which also means the relative frequencies of change occurrence are not identical over different system configurations. We use Fisher's exact test of independence due to our small sample size, according to McDonald [74] with two-sided alternative hypothesis. We choose to report Cramer's V as the effect size since it can be compared across studies, With a range between 0 and 1, it can be interpreted as how strong two categorical variables are associated with each other [3].

Besides the hypothesis testing approach, we use descriptive statistics to support our findings. Also, we apply logistic regression to examine the effect of confounding factors that can affect both the independent and dependent variables. Change occurrence is used as the response variable in this regression analysis. We use a zero coefficient test (i.e., Wald test) and calculate the confidence interval to determine if a coefficient is unlikely to be zero. Variance inflation factors are also computed to checked multicollinearity (i.e., each predictor cannot be easily predicted by using the others).

*4.4.2 Second Analysis: Characteristics of Opinion Change Related to Other Factors.* For the second analysis pipeline, we further inspect the characteristics of two different pairs of participant groups among system configurations 1 and 2. First, we want to understand what is the combination of factors and system configurations that may be related to opinion change. This first pair is about change occurrence: one group that changes their opinions, and another group that does not change opinions. For the first pair of groups, we are interested in the total number of selected motivations, Empathic Concern levels, and Perspective Taking levels. Second, we want to inspect if there is a relationship between the type of selected motivations (middle vs. non-middle on the political spectrum) and the final opinion that the user landed. The second pair is about the final opinion: one group that chooses their final opinion as the "middle one" on the liberal-restrictive spectrum, and another group that chooses the non-middle opinion as the final one. For the second pair of groups, we want to inspect the number of motivations that these two groups choose for each opinion, separated by system configurations 1 and 2. The middle opinion is "*The university should support the hybrid setting to enable both physical and virtual presence (for example, using scheduling systems or masks)*", as shown in Figure 5. When comparing the differences between pairs of groups, we use the two-sided Mann-Whitney U test since our data is not normally distributed, which is a non-parametric form of the unpaired t-test. We also report the absolute vale of Cliff's Delta (calculated using the test statistics) as the effect size, which is a typical measure for Mann-Whitney U test and can be interpreted as the degree of overlap between two distributions. Cliff's Delta is directional and ranges between -1 and +1, with -1 and +1 meaning no overlap and 0 means complete overlap [70].

### 4.5 Participants and Sample Size

We use the Prolific platform to recruit online participants to conduct the study. Participants are screened using the platform's demographic pre-screening feature to be adults (18 years of age and

older) fluent in English and have a task approval rating over 90% on the Prolific platform. We also restrict participation to only desktop devices (no mobile or tablet). Also, we apply the balanced sampling feature on Prolific to distribute the study evenly among female and male participants. Participants are paid based on the hourly wage of 7.5 GBP (about 10.3 USD), indicated as a good pay by the Prolific platform. Participants took 16 minutes on average (with a standard deviation of 9 minutes) to complete the study.

We use the G*Power software [32] to estimate the sample size. From the controlled experiment point of view, we have three system configurations, which means three groups.

For a two-tailed Fisher's exact test, using significance level $\alpha = 0.017$ (after Bonferroni correction), power $1 - \beta = 0.8$, change occurrence proportion $p_2 = 0.12$ for the system configuration that shows motivations, change occurrence proportion $p_1 = 0.02$ for the control condition, and allocation ratio 1 (ratio between system configuration groups), we obtain a sample size 140 for each group.

During the study period, we recruited a total of 450 participants. After filtering out the responses that are incomplete, do not provide consent, and have insufficient data quality (failing more than one instructional manipulation check and more than one reversed question check), we have 420 valid responses for analysis. We have 137, 140, and 143 responses for the three system configurations, respectively. Table 9 summarizes the participants' demographic data, which shows that female and male participants are balanced (due to the balanced sampling method provided by Prolific), as well as the student status. However, most of the participants have age below 45 and are from European countries. Besides, slightly more participants have a higher education degree (including Associate's, Bachelor's, Master's, and Ph.D. degrees) and no full-time job.

Details regarding the demographics are reported in the Appendix H.

## 5 Results

We found that showing peoples' motivations help in shifting opinions when compared to the control condition, even after adjusting for confounding factors. Moreover, the crowdsourcing empirical study identified that empathy (both the Empathic Concern and the Perspective Taking levels) is unrelated to opinion change. Regarding behavior, participants who change opinions tend to choose more motivations. Also, participants who choose the middle opinion tend to select more motivations corresponding to the middle opinion and fewer motivations corresponding to the non-middle opinion. Below we explain these findings in more detail.

### 5.1 Effectiveness of Showing Motivations and the Confounding Factors

As shown in Table 3, showing motivations to users results in more opinion changes (12.9% for the text-only configuration, and 10.2% for the text-with-image configuration) than the control condition (2.1%). To demonstrate the differences among system configurations in opinion changes, we show the result of the Fisher's exact test in Table 5. Regarding change occurrence, there is statistical significance in both the text-only and text-with-image configurations when compared with the control condition. Cramer's V indicates a small to medium effect size (based on the interpretation of Kim [55]). However, there is no statistical difference between the text-with-image and text-only configurations.

To further inspect the opinion change pattern, we plot Sankey diagrams (Figure 6) that show how people change their opinions from one to another among all three system configurations, excluding those who do not change opinions. From these diagrams, the control condition shows an apparent difference visually when compared to the configurations that show other people's motivations. Also, for the configurations that show motivations, Table 4 shows that a large portion of the participants who change opinions choose the middle one on the liberal-restrictive spectrum

Table 3. The table below shows the contingency table for change occurrence. For example, 14 (10.2%) participants changed their opinions when the system showed other people's motivations using text with images.

| Configuration | No Opinion Change | Has Opinion Change | Sum | Percentage of Change |
|---|---|---|---|---|
| Text with Image | 123 | 14 | 137 | 10.2% |
| Text Only | 122 | 18 | 140 | 12.9% |
| Control Condition | 140 | 3 | 143 | 2.1% |
| Sum | 385 | 35 | 420 | 8.3% |

Table 4. The tables below show the cross-tabulation of change occurrence and whether the final opinion is the middle one on the liberal-restrictive spectrum. This result suggests that showing other people's motivations is related to more opinion changes toward the middle (i.e., centrist). The blue-marked cells correspond to the blue paths regarding the opinion change patterns in Figure 6.

| **Text with Image** | No Opinion Change | Has Opinion Change | Sum |
|---|---|---|---|
| Final Opinion is Middle | 84 | 10 | 94 (68.6%) |
| Final Opinion is not Middle | 39 | 4 | 43 (31.4%) |
| Sum | 123 (89.8%) | 14 (10.2%) | 137 (100%) |

| **Text Only** | No Opinion Change | Has Opinion Change | Sum |
|---|---|---|---|
| Final Opinion is Middle | 87 | 13 | 100 (71.4%) |
| Final Opinion is not Middle | 35 | 5 | 40 (28.6%) |
| Sum | 122 (87.1%) | 18 (12.9%) | 140 (100%) |

| **Control Condition** | No Opinion Change | Has Opinion Change | Sum |
|---|---|---|---|
| Final Opinion is Middle | 88 | 1 | 89 (62.2%) |
| Final Opinion is not Middle | 52 | 2 | 54 (37.8%) |
| Sum | 140 (97.9%) | 3 (2.1%) | 143 (100%) |

Table 5. The tables below show the Fisher's exact test result for system configuration pairs on the variables of change occurrence. Each pair is a 2×2 contingency table (transformed from Table 3). The control condition does not show motivations, while others show the motivations. The p-values that are marked using the asterisk symbol (and in a highlighted row) show statistical significance using the 0.017 significance level, after the Bonferroni correction. Cramer's V is used as the effect size. The abbreviation "DoF" means the degree of freedom.

| **Fisher's Exact Test with Change Occurrence** | | | | | |
|---|---|---|---|---|---|
| Group 1 | Group 2 | Test Statistic | p-value | DoF | Cramer's V |
| Text with Image (n=137) | Control Condition (n=143) | 0.1883 | 0.0051* | 1 | 0.1550 |
| Text Only (n=140) | Control Condition (n=143) | 0.1452 | 0.0005* | 1 | 0.1918 |
| Text with Image (n=137) | Text Only (n=140) | 1.2963 | 0.5742 | 1 | 0.0300 |

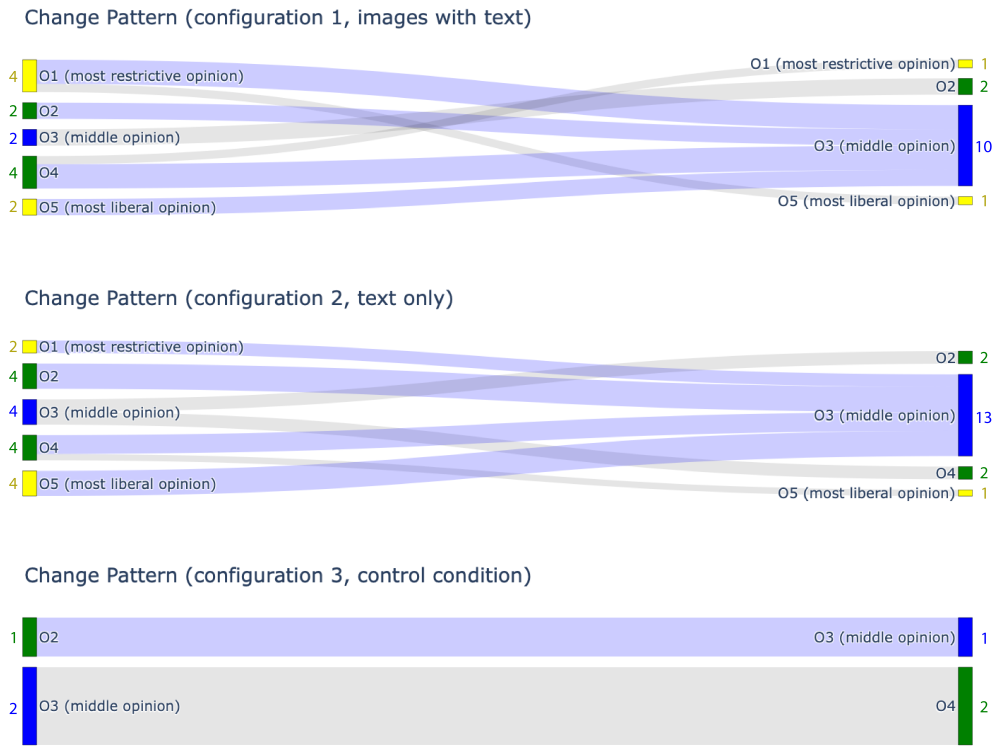



Fig. 6. This figure shows the Sankey diagrams of the opinion change patterns for all configurations (except those participants that do not change their opinions). The labels at the left and right indicate the counts. For example, in the image-with-text configuration, 10 people changed their opinions to the middle one. According to Table 4, many people stays at the middle opinion (84 out of 137 for the image-with-text configuration, 87 out of 140 for the text-only configuration). This suggests that opinions tend to converge to the middle one (i.e., the one in the middle of the liberal-restrictive spectrum) in system configuration 1 and 2. In Table 8, we further confirm the influence of the number of selected motivations on opinion change. The blue paths mean that the opinions are changed to the middle one from other opinions. The gray paths mean that the opinions are changed to either the more liberal or restrictive ones. The descriptions of the opinions are in Table 2. The numbers that summarize the blue and gray paths are in Table 4.

as the final opinion (10 out of 14 for the text-with-image configuration, and 13 out of 18 for the text-only configuration).

Table 6 shows the result of logistic regression using change occurrence as the response variable. All the demographics are included as the predictor variables, as well as the system configuration (which is the independent variable), empathy levels (including perspective-taking and empathic concern), and vote importance. The variance inflation factors of the predictors are all below 1.5, which means low multicollinearity. The result indicates that *vote importance* has a confounding effect ($p < .05$, and the confidence interval does not include zero).

Notice that showing motivations in the system configuration has a positive impact (i.e., coefficient larger than zero) on change occurrence. Regarding vote importance, the positive coefficient indicates

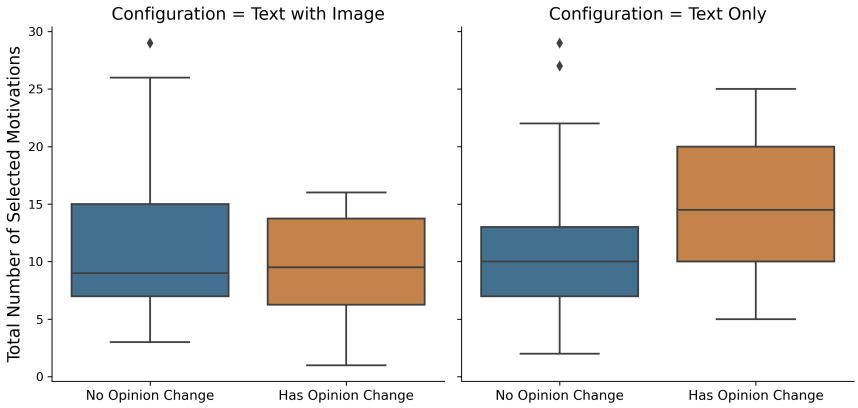



Fig. 7. The above figure shows the distribution of the number of selected motivations (as shown in Figure 4) by system configurations between the groups that change and do not change their opinions.

that participants who think other people's vote is more important tend to change their opinion. This is in line with previous works in online deliberation [62, 101]

### 5.2 Characteristics of Opinion Change Related to Other Factors

Regarding the group pairs of change occurrence (no opinion change vs. with change), the result is in Table 7. In the text-only configuration, people who change opinions select more motivations (statistically significant) than the other group of people who do not change opinions (median 14.5 vs. 10 selected motivations). This finding is also illustrated in Figure 7, suggesting evidence that people who change opinions tend to select more motivations. This could also imply that people who change their opinions spend time checking other people's motivations. However, there is no statistically significant difference in the Perspective Taking and Empathic Concern levels for the system configurations that show motivations.

Regarding the group pairs of whether the final opinion is the middle one, the result is in Table 8. The middle opinion is considered the most balanced one (i.e., centrist), which is the hybrid education setting (refer to "O3" in Table 2). Specifically, the result shows that participants who ended up choosing the middle opinion tend to select more motivations corresponding to the middle opinion (statistical significance for both configurations) and fewer motivations from the non-middle opinions (statistical significance for the text-only configuration). This finding suggests that the participants are, to some degree, coherent with their choices of opinions and motivations.

## 6 Discussion

Our work contributes to the domain of HCI and participatory policy-making with a specific focus on the emerging notion of empathic-centric design at scale. In the next sections, we discuss our findings with respect to other related works, derive implications for the design of tools and methods to support participatory methods, and elaborate on the deep ramifications and consequences of the empathic-centric design of policies.

### 6.1 Implications for Deliberation Platforms

Our analysis found that showing other people's motivations helps shift opinions, even after adjusting for confounding factors. There is a statistically significant difference in the occurrence of opinion change between the control condition and both the one that showed text together with images and

Table 6. The following table shows the analysis result of confounding factors using a logistic regression model (using the change occurrence dependent variable). The pseudo R-squared value for fitting the model is 0.13 (which is treated as the effect size). All the variance inflation factors (except the intercept) are below 1.5, showing low multicollinearity. The p-values that are marked using the asterisk symbol (and highlighted) indicate statistical significance using the 0.05 significance level. Abbreviations "Coef", "Std", and "CI" mean the coefficient of the variable, the standard error, and the 95% confidence interval respectively. The Std, Z statistic, p-value, and CI come from the Wald test on the coefficient.

| **Logistic Regression Using the Change Occurrence as the Response Variable** | | | | | |
|---|---|---|---|---|---|
| Predictor Variable | Coef | Std | Z statistic | p-value | CI |
| Intercept (the constant in regression) | -4.60 | 1.85 | -2.48 | 0.013 | [-8.23, -0.97] |
| Does the system configuration show motivation? | 1.72 | 0.62 | 2.75 | 0.006* | [0.49, 2.94] |
| Sex | 0.73 | 0.40 | 1.82 | 0.068 | [-0.05, 1.51] |
| Education Status | 0.73 | 0.43 | 1.71 | 0.088 | [-0.11, 1.57] |
| Location | -0.71 | 0.38 | -1.84 | 0.066 | [-1.46 0.05] |
| Student Status | 0.62 | 0.44 | 1.39 | 0.163 | [-0.25, 1.48] |
| Job Status | 0.26 | 0.41 | 0.65 | 0.516 | [-0.53, 1.06] |
| Vote Importance | 0.88 | 0.41 | 2.16 | 0.031* | [0.08, 1.69] |
| Perspective Taking Level (empathy) | 0.30 | 0.47 | 0.63 | 0.527 | [-0.62, 1.21] |
| Empathic Concern Level (empathy) | -0.16 | 0.37 | -0.45 | 0.655 | [-0.89, 0.56] |
| Age Range | 0.06 | 0.26 | 0.22 | 0.828 | [-0.45, 0.56] |

Table 7. The table below shows the result of hypothesis testing (using the Mann-Whitney U test) on factors between the change occurrence groups. The "No Opinion Change" and "Has Opinion Change" columns show "median±semi-interquartile range" of the factors. The "n" value in the parentheses of these two columns indicates the group size. We use Cliff's delta as the effect size. The p-values that are marked using the asterisk symbol (and highlighted) indicate statistical significance using the 0.05 significance level.

| **Mann-Whitney U test on the Total Number of Selected Motivations (see Figure 7)** | | | | | |
|---|---|---|---|---|---|
| Configuration | No Opinion Change | Has Opinion Change | U Statistic | p-value | Cliff's Delta |
| Text with Image | 9.00±4.00 (n=123) | 9.50±3.75 (n=14) | 917.0 | 0.693 | 0.07 |
| Text Only | 10.00±3.00 (n=122) | 14.50±5.00 (n=18) | 661.0 | 0.006* | 0.40 |

| **Mann-Whitney U test on the Empathic Concern Level** | | | | | |
|---|---|---|---|---|---|
| Configuration | No Opinion Change | Has Opinion Change | U Statistic | p-value | Cliff's Delta |
| Text with Image | 4.00±0.36 (n=123) | 4.07±0.43 (n=14) | 846.5 | 0.920 | 0.02 |
| Text Only | 3.93±0.50 (n=122) | 4.00±0.27 (n=18) | 990.5 | 0.504 | 0.10 |

| **Mann-Whitney U test on the Perspective Taking level** | | | | | |
|---|---|---|---|---|---|
| Configuration | No Opinion Change | Has Opinion Change | U Statistic | p-value | Cliff's Delta |
| Text with Image | 3.71±0.29 (n=123) | 3.79±0.29 (n=14) | 699.5 | 0.250 | 0.19 |
| Text Only | 3.71±0.34 (n=122) | 3.79±0.29 (n=18) | 1023.0 | 0.641 | 0.07 |

Table 8. The table below shows the result of hypothesis testing (using the Mann-Whitney U test) on factors between the "Final Opinion is not Middle" and "Final Opinion is Middle" groups.

| **Mann-Whitney U test on the Number of Selected Motivations for the Middle Opinion (see Figure 8)** | | | | | |
|---|---|---|---|---|---|
| Configuration | Final Opinion is not Middle | Final Opinion is Middle | U Statistic | p-value | Cliff's Delta |
| Text with Image | 2.00±1.00 (n=43) | 3.00±1.38 (n=94) | 1565.5 | 0.031* | 0.23 |
| Text Only | 2.50±1.13 (n=40) | 3.00±1.00 (n=100) | 1573.0 | 0.045* | 0.21 |

| **Mann-Whitney U test on the Number of Selected Motivations for the Non-Middle Opinions (see Figure 8)** | | | | | |
|---|---|---|---|---|---|
| Configuration | Final Opinion is not Middle | Final Opinion is Middle | U Statistic | p-value | Cliff's Delta |
| Text with Image | 8.00±2.50 (n=43) | 7.00±3.50 (n=94) | 2151.5 | 0.545 | 0.06 |
| Text Only | 8.50±2.00 (n=40) | 7.00±2.50 (n=100) | 2513.5 | 0.018* | 0.26 |

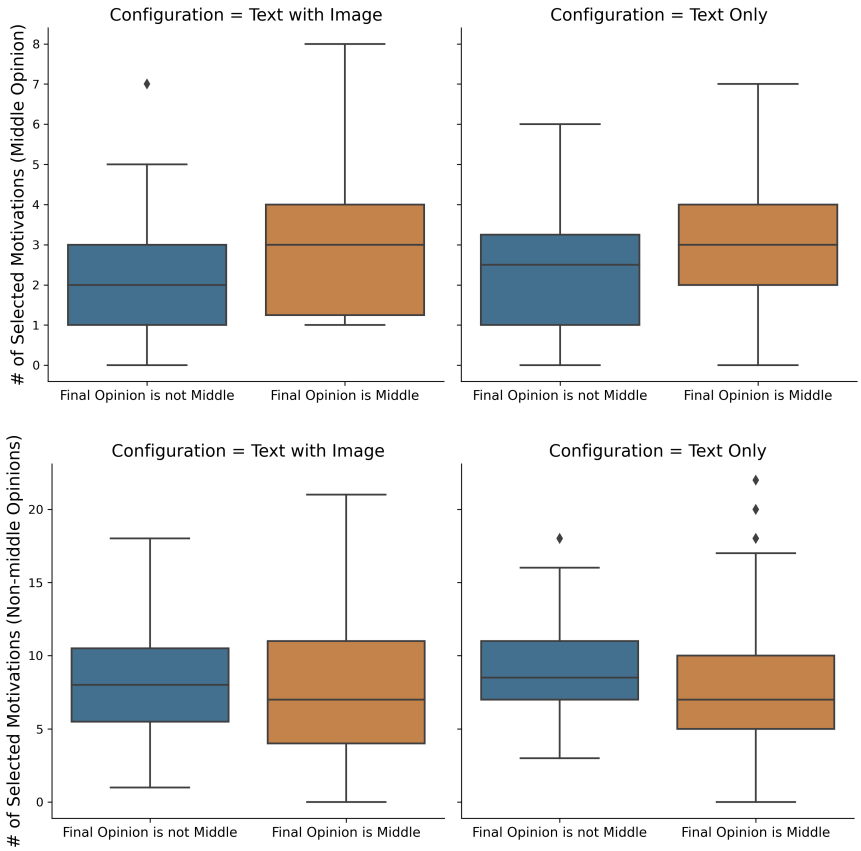



Fig. 8. The above figures show the distributions of two factors by system configurations between the groups that end their opinions on the middle one (on the liberal-restrictive spectrum) or not. These two factors are the number of selected motivations for only the middle opinion or others.

only text. This finding is aligned with the literature where showing other people's motivations has the potential to evoke empathy, which can lead to attitude changes [6, 62]. However, there is no statistically significant difference between the image with text configuration and the text-only configuration. This finding is inconsistent with previous works, as the literature suggested that a richer representation of the information can be better [21, 86]. In contrast, our result indicates that using richer media – in our case, text together with images – to represent information is not always the best design choice. These results may imply that, when designing the representation form of the motivations, we need to be careful about potential information overload. It is possible that the configuration of images with text takes more time for people to process information and make the communication of motivations overly complicated [43, 83]. Our finding also suggests that the text-only configuration is more effective than the images with text configuration. For example, there is no significance in the number of selected motivations between the groups that change and do not change opinions for the text with image configuration, while there is significance in the text-only configuration. Similarly, this behavior difference also exists in the number of selected motivations for the non-middle opinion between the groups that select the middle opinion as the final one or not. These behavior differences may indicate that participants primarily spent time processing the information in the images instead of the motivations themselves. For future works, it would be interesting to measure the real time spent on each section of the study, and investigate if there is some correlation. Also, investigating if the the type of motivation chosen relates with their final decision. However, a large portion of the participants did not change their minds in our study, implying that we may need an even larger sample size to confirm whether the text-only configuration is more effective.

We have to point out that this research does not aim to make people change their minds but to understand how people change their minds, especially in reaching a more inclusive opinion. We found that the behavior of selecting motivations is, to some degree, related to opinion changes, especially for the middle opinion. Specifically, people who change their minds tend to select more motivations, meaning people who pay more attention to other people's motivations may tend to understand others' perspectives. Also, participants who change their minds may be coherent in choosing the motivations corresponding to their final opinion. In general, these findings agree with previous works related to digital-mediated empathy and persuasive system design that shows how motivations help people to empathize with other and reflect on other points of view [21, 58, 86]. Also, this phenomenon can happen in a relatively short period (i.e., the duration of the experiment) and a small piece of text, which means this type of intervention has the potential to be easily embedded in existing tools. We believe this finding suggests a promising path that could lead to inclusive solutions and be worth using control experiments to inspect further ways of enabling people to interact with other people's opinions and how they affect opinion changes. This finding may be applied in two situations. First, in the situation when the policy-makers are not expecting a predefined solution, using a specific interaction design and information representation can lead to convergence of opinions, which may benefit policy-makers in making urgent and timely decisions. The second situation is that the decision-makers already have an inclusive solution and seek to push out the policy for public communication. In this case, the interaction modality can help policy-makers efficiently communicate with the public and engage a large group of people with access to digital technology. However, it is vital not to fall into the trap of manipulating people's opinions by explicitly pushing a policy that can harm minority groups, as there is a risk that the majority can converge to a decision that only benefits the majority group. Also, our approach should not be used alone and needs to be integrated with the current opinion polling process. Our goal in this work is not to develop a new method to replace the current policy-making process but rather to support it by obtaining a broader view of social issues from the citizens.

### 6.2 The Role of Empathy in Deliberation

While we begun our work with the assumption empathy would play a critical role, our analysis indicates no statistically significant effect regarding participants' empathy levels (neither Empathic Concern nor Perspective Taking scores) on opinion changes. The statistics show that the result is not borderline; instead, they are highly likely to be unrelated. This seems to contradict previous works in the psychology domains that show how empathy plays a role in the decision-making process [35, 79, 89, 90, 93]. We think that this contradiction could due to the following reasons. First, it is possible that other types of empathy could affect opinion changes. In our experiment, we only consider Empathic Concern and Perspective Taking. Also, it could be that the online environment requires more nuanced interaction design approaches to evoke empathy. Our approach only enables participants to browse and select their motivations. Furthermore, the hypothetical scenario that we choose may not evoke much empathy, as participants can already have strong opinions on how students and teachers should return to school to work. Our scenario is not described as a social dilemma, as it does not offer choices that could explicitly lead to conflicts among different groups of people or significant bias toward a particular social group. It may require using other specific contexts to evoke empathy at the level that could be measured. We leave the exploration of more types of empathy items, more interaction design approaches, and more scenarios to future work. However, on the other hand, the fact we observe that opinion change occurs independently from the empathy scores could mean that showing peoples' motivations in this way allows participants to understand other perspectives regardless of their intrinsic ability to empathize. It could be that a design intervention as simple as showing people's motivation for a choice (using text or images) is sufficient to trigger a change of perspectives, which requires further studies to confirm.

### 6.3 Policy Sandboxing: Future Directions and Positioning in Existing Participatory Practices

Through our contribution, we have exemplified the means of conducting *policy sandboxing*, i.e. the rapid and participatory evaluation of policies with citizens who have different and often conflicting needs, experiences and perceptions regarding a policy proposal. Not only does policy sandboxing involve testing policy proposals and adjusting them based on the numerous perspectives of citizens who will be the potential beneficiaries of that policy, but we also explored how exposure to others' motivations and perspectives regarding a given proposal enables citizens to find common ground by changing their own initially held position. We particularly sought to understand how varied representations of citizens' perspectives (text and images in our case) enable individuals to calibrate and adjust their opinions. Although empathy has been a central tenet in numerous design research methods, these methods have been observed to be hyper-local and fail to scale-up [16]. Moreover, the role of empathy in participatory policy-making has led to mixed results, where empathy evoked by exposure to the experiences and concerns of others has been observed to increase attitudinal change and critical reflection among citizens [78], at the same time, this effect has not been homogeneous among people with divergent political beliefs [60]. Although our study did not take into account the partisan associations of our participants, our observation of the change in participants' opinions after exposure to the motivations of others is consistent with the earlier findings of Muradova and Arceneaux [78], suggesting that empathy may have been a contributing factor. However, we found no evidence to support the role of empathy in participants' opinion change.

Furthermore, existing deliberation platforms, which afford for the participation of citizens at scale, and expression of one's perspectives and experiences, do not necessarily embody empathy as an enabler for grounding mutual expectations and perspectives and, more importantly, consolidate other's worldviews with one's own. These issues have resulted in the development of policies that

either fail to capture the complexities and nuances of citizens' needs leading to imbalanced focus, or seek to optimize high-level demographic indicators resulting in policies that are disconnected from citizens' needs and experiences altogether. In past years we have seen an increased interest in assimilating empathy as a design lens in HCI, which is evident from the recent discourses, such as the *Empathy-Centric Design* workshops at CHI [27, 29, 73] which sought to reframe the emerging themes around empathy and devised the future research agenda to examine empathy and its role in design and evaluation of systems and interventions. Based on these emerging discourses on the role and importance of empathy in HCI and CSCW, we believe it is crucial to incorporate and empirically evaluate how empathy could mediate (if not directly influence) constructive discussions around policy making and the participatory development of inclusive policies.

Our research has sought to expose the participants to diverse visions, which not only evoke emotional responses but also afford for cognitive perspective taking. In this way, we have aimed for a balanced internal assessment of the problem at hand in relation to others. Our results have also demonstrated that even though participants' empathetic tendencies –measured in the pre-study questionnaire– did not statistically explain participants' change of opinions, the interplay of exhibited visions and participants' initial motivations was found to influence their change in opinions, which was not the case in the control condition. Considering participants' change of opinion as an indicator of empathetic alignment (i.e., updating one's position through consolidating others' experiences and visions), we can argue that our intervention demonstrates the ways of conducting rapid "usability tests" of policies at scale with multiple stakeholders. Moreover, our choice of crowdsourcing as a crucial instrument that underpins stakeholder engagement, on the one hand, enables policy-makers to engage many participants from diverse geographical regions. On the other hand, similar to survey research, it makes our approach susceptible to sampling bias (higher or lower representation of certain sections of the population) and coverage errors (missing citizens who do not use such platforms) [20]. Still, our work presents a viable proof-of-concept for Policy Sandboxing that embodies empathy-centric design.

We further ask ourselves about the positioning of Policy Sandboxing: when and how often it can be employed, and how it relates to existing HCI approaches. In our conception of inclusive and participatory policy-making, our contribution offers an instrument, i.e., a means to an end, to engage diverse communities and a large number of citizens in examining if the specific policy is attuned to their needs. Policy-makers, civic bodies, or concerned citizens can employ Policy Sandboxing rapidly and frequently to assess and/or identify the most fitting policies. In addition, diverse stakeholders can independently conduct their sandboxing experiments while still engaging multiple stakeholders and, at a later stage, compare the divergences and consolidate the commonalities. Moreover, we can argue that our approach is not isolated from other approaches in participatory policy-making and can be utilized in tandem with other methods. For example, contextmapping [99, 118] and co-design methods can be employed to contextualize the problem and frame it in collaboration with specific community representatives, followed by community citizen science (for example, [7, 48]) with a broader population to corroborate the extent of the problem and its impact on concerned communities. Finally, Policy Sandboxing can be applied at a much larger scale with the general populace on a contextualized and well-defined set of perspectives and experiences, which were collected through other prior means. In this way, the example above illustrates that Policy Sandboxing is complementary to other local participatory policy-making approaches within HCI and beyond to identify and capture opinions and experiences.

Future research should explore ways to integrate Policy Sandboxing into the policymaking process and examine whether the policy proposals tested through our approach are implemented and accepted (and to what extent).

Finally, despite our arguments in favor of designing with empathy for fostering inclusive policy-making, we must consider the ethical implications of designing with empathy. On the one hand, empathy as a design lens can empower citizens to understand better the perspectives and experiences of diverse stakeholders and thus proactively shape policies in the making. On the other hand, the choice of biased and imbalanced opinions and experiences as visions may render empathy an instrument for citizen manipulation at large scales. Recent past works in persuasive system design within online and social media platforms have underlined the ethical implications of designing with empathy and persuasion (for example, [14, 15, 54]). Consequently, it is imperative to check and mitigate the negative implications of empathy-centric design through the following. First, we need to enable policy-makers, civic societies, and communities to independently monitor and audit the implemented visions, motivations, opinions, and outcomes of the sandboxing process. Second, Policy Sandboxing needs to be embedded within participatory policy-making workflows so that it cannot be dissociated from other complementary approaches (as discussed above). Finally, we have to engage diverse stakeholders and interdisciplinary scholarship more broadly in examining the overarching impact of empathy-centric design and guide future discourses in inclusive policy-making practices.

### 6.4 Limitations

This study has some limitations in the research procedure. First, participants are assigned roles representing different stakeholders, which is our design choice to place people in various contexts. But there is no statistically significant difference among the groups with different roles in opinion change occurrence, change patterns, the number of selected motivations, starting opinion, and the final opinion. This limitation may imply that our role assigning mechanism does not enable participants to immerse themselves into the assigned roles. Future work is needed to recruit various local stakeholders or explore other methods to make the participants identify themselves with different stakeholders.

Second, we tried to be as unbiased as possible when creating the opinions and their motivations based on the conversations around the scenario that had already happened at the time of conducting the experiment. But it is undeniable that participants could have been affected by our cultural background and beliefs that we implicitly added to the study materials. When creating the materials, our goal is not to list all possible opinions and motivations but instead to provide options that cover various perspectives, from the most to the least restrictive Future research can thus explore different hypothetical scenarios and apply an iterative procedure to first collect materials from a set of stakeholders and then later use the materials in the experiment.

We acknowledge that the interaction presented in our study looks like a form of pseudo-participation as described in [85], however, this was just because we needed to control that dimension of the experiment. In the same way, asking the participants to take a role can be seen as a form of priming, however, this is required just for the study, and it would not be included in a real-world deployment.

We also acknowledge that using empathy in the deliberation process could emphasize the role of emotive reactions instead of rational thinking. This could lead to situations where our approach can be misused to manipulate the deliberation process [56], as previous literature argued that emotions do not make the process more democratic [95]. Future works in Policy Sandboxing needs to take this into account.

Finally, the participants we recruited are limited to people who are on the Prolific platform, have access to digital technology, and are fluent in using it. Our sampled participants may not reflect completely the population that is involved in policy-making and affected by the problem. The study

can be further extended to involving citizens and stakeholders at the city scale, thus obtaining a genuinely diverse view of a social issue in a local region.

## 7 Conclusion

In this work, we investigated how to bring empathy to participatory policy-making at scale. In particular, we studied how using text and images to represent people's motivation behind a choice can influence how others empathize and understand different views. Our crowdsourced empirical study on Prolific revealed that simply exposing people to others' motivations, using text and images, has a significant effect on people's ability to understand and empathize with other perspectives, leading them to change opinion, often towards a more balanced and inclusive one. This opinion shift not only appears to be independent of the empathy score of the participants, but also it happens coherently. People who select many motivations related to the most inclusive opinion choose the opinion as their final one.

We further reflected on the overarching implications of our approach, *Policy Sandboxing*, on the existing policy-making practices and outcomes, including its positioning and relationship with existing participatory policy-making approaches within HCI and beyond. A design method based on our approach could allow policymakers not only to engage with a large number of individuals to quickly run studies on policies but also to embody empathy-centric design in their process enabling them to design more inclusive policies. Finally, we discussed the ethical dimension of leveraging empathy in designing policies. While empathy can empower citizens, it can also be instrumentalized for large-scale manipulation and provide viable pathways for mitigating the risks and enabling multi-stakeholder contestation in policy-making workflows.

## Acknowledgments

This work was partially supported by Data4Health ANR and the EU H2020 research and innovation programme, COVID-19 call, under grant agreement No. 101016233 "PERISCOPE" projects.

## References

[1] Dinislam Abdulgalimov, Reuben Kirkham, Stephen Lindsay, James Nicholson, Vasilis Vlachokyriakos, Emily Dao, Daniel Kos, Daniel Jitnah, Pam Briggs, and Patrick Olivier. 2023. Designing for the embedding of employee voice. *Proceedings of the ACM on Human-Computer Interaction* 7, CSCW1 (2023), 1–31.

[2] Tanja Aitamurto, Daniel Catterson, Camille Crittenden, Chris Garland, Allen Ching-Chang Huang, Sanjay Krishnan, Matti Nelimarkka, Gavin Newsom, Jay Patel, John Scott, et al. 2014. The California Report Card: A Mobile Crowdsourcing Tool for Timely Public Policy Advice. *Crowdsourcing for Politics and Policy. Oxford Internet Institute: Internet, Politics and Policy* (2014).

[3] Haldun Akoglu. 2018. User's guide to correlation coefficients. *Turkish journal of emergency medicine* 18, 3 (2018), 91–93.

[4] Ahmad Alaassar, Anne-Laure Mention, and Tor Helge Aas. 2020. Exploring how social interactions influence regulators and innovators: The case of regulatory sandboxes. *Technological Forecasting and Social Change* 160 (2020), 120257.

[5] Hilary J Allen. 2019. Regulatory sandboxes. *Geo. Wash. L. Rev.* 87 (2019), 579.

[6] Pablo Aragón, Andreas Kaltenbrunner, Antonio Calleja-López, Andrés Pereira, Arnau Monterde, Xabier E Barandiaran, and Vicenç Gómez. 2017. Deliberative platform design: The case study of the online discussions in Decidim Barcelona. In *Social Informatics: 9th International Conference, SocInfo 2017, Oxford, UK, September 13-15, 2017, Proceedings, Part II 9*. Springer, 277–287.

[7] Mara Balestrini, Yvonne Rogers, Carolyn Hassan, Javi Creus, Martha King, and Paul Marshall. 2017. A City in Common: A Framework to Orchestrate Large-Scale Citizen Engagement around Urban Issues. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 2282–2294. https://doi.org/10.1145/3025453.3025915

[8] Eric P. S. Baumer, Claire Cipriani, Mitchell Davis, Gary He, James Kang, Jaclyn Jeffrey-Wilensky, Jinjoo Lee, Justin Zupnick, and Geri K. Gay. 2014. Broadening Exposure, Questioning Opinions, and Reading Patterns with Reflext:

a Computational Support for Frame Reflection. *Journal of Information Technology & Politics* 11, 1 (2014), 45–63. https://doi.org/10.1080/19331681.2013.872072 arXiv:https://doi.org/10.1080/19331681.2013.872072

[9] Jan Behrens, Axel Kistner, Andreas Nitsche, and Björn Swierczek. 2014. *The principles of LiquidFeedback*. Interacktive Demokratie.

[10] Maksim Belitski, Christina Guenther, Alexander S Kritikos, and Roy Thurik. 2022. Economic effects of the COVID-19 pandemic on entrepreneurship and small businesses. *Small Business Economics* 58, 2 (2022), 593–609.

[11] Devis Bianchini, Daniela Fogli, and Davide Ragazzi. 2016. Promoting Citizen Participation through Gamification. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction* (Gothenburg, Sweden) *(NordiCHI '16)*. Association for Computing Machinery, New York, NY, USA, Article 8, 4 pages. https://doi.org/10.1145/2971485.2971543

[12] Simon Elias Bibri and John Krogstie. 2017. Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society* 31 (2017), 183–212. https://doi.org/10.1016/j.scs.2017.02.016

[13] Paul Biedermann, Jorgos Coenen, Dries De Roeck, and Andrew Vande Moere. 2023. PosterTalk: Expanding Participatory Agency in Public Survey Platforms via Middle-Out Gatekeeping. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference*. Association for Computing Machinery, New York, NY, USA, 2573–2592.

[14] Gustav Borgefalk and Nick de Leon. 2019. The ethics of persuasive technologies in pervasive industry platforms: the need for a robust management and governance framework. In *International Conference on Persuasive Technology*. Springer, 156–167.

[15] Marietjie Botes. 2023. Autonomy and the social dilemma of online manipulative behavior. *AI and Ethics* 3, 1 (2023), 315–323.

[16] John M Carroll, Blaine Hoffman, Kyungsik Han, and Mary Beth Rosson. 2015. Reviving community networks: hyperlocality and suprathresholding in Web 2.0 designs. *Personal and Ubiquitous Computing* 19, 2 (2015), 477–491.

[17] Adrian Choi, Catherine D'Ignazio, Brooke Foucault Welles, and Andrea G Parker. 2023. Social Media as a Critical Pedagogical Tool: Examining the Relationship between Youths' Online Sociopolitical Engagements and Their Critical Consciousness. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*. Association for Computing Machinery, New York, NY, USA, 1–25. https://doi.org/10.1145/3544548.3580823

[18] Rachel Elizabeth Clarke, Jo Briggs, Andrea Armstrong, Alistair MacDonald, John Vines, Emma Flynn, and Karen Salt. 2021. Socio-materiality of trust: co-design with a resource limited community organisation. *CoDesign* 17, 3 (2021), 258–277.

[19] Stephen Coleman and Giles Moss. 2012. Under construction: The field of online deliberation research. , 15 pages.

[20] Mick P Couper. 2000. Web surveys: A review of issues and approaches. *The Public Opinion Quarterly* 64, 4 (2000), 464–494.

[21] Max T. Curran, Jeremy Raboff Gordon, Lily Lin, Priyashri Kamlesh Sridhar, and John Chuang. 2019. *Understanding Digitally-Mediated Empathy: An Exploration of Visual, Narrative, and Biosensory Informational Cues*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3290605.3300844

[22] Dimitrios Darzentas, Harriet Cameron, Hanne Wagner, Peter Craigon, Edgar Bodiaj, Jocelyn Spence, Paul Tennent, and Steve Benford. 2022. Data-inspired co-design for museum and gallery visitor experiences. *AI EDAM* 36 (2022), 24 pages.

[23] Janet Davis, Lisa P Nathan, et al. 2015. Value sensitive design: Applications, adaptations, and critiques. *Handbook of ethics, values, and technological design: Sources, theory, values and application domains* (2015), 11–40.

[24] Mark H Davis. 1983. Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of personality and social psychology* 44, 1 (1983), 113.

[25] Mark H Davis et al. 1980. A multidimensional approach to individual differences in empathy. *Journal of Personality and Social Psychology* 10 (1980), 113–126.

[26] Antonio De Nicola, Sonia Giovinazzi, Massimo Guarascio, Paola Rizzi, and Maria Luisa Villani. 2020. Gamified Decision Making for a Participatory Post-Crisis Recovery: A Model based Process. In *Proceedings of the 30th European safety and reliability conference—ESREL*. Research Publishing, 1937–1943. https://doi.org/10.3850/978-981-14-8593-0_5012-cd

[27] Alok Debnath, Allison Lahnala, Uğur Genç, Ewan Soubutts, Michal Lahav, Tiffanie Horne, Wo Meijer, Yun Suen Pai, Yen-Chia Hsu, Giulia Barbareschi, Himanshu Verma, and Andrea Mauri. 2024. Empathy-Centric Design: Scrutinizing Empathy Beyond the Individual. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '24* (Honolulu, Hawaii) *(CHI EA '24)*. Association for Computing Machinery, New York, NY, USA, 7 pages. https://doi.org/10.1145/3613905.3636297

[28] Pieter MA Desmet, Martijn H Vastenburg, and Natalia Romero. 2016. Mood measurement with Pick-A-Mood: review of current methods and design of a pictorial self-report scale. *Journal of Design Research* 14, 3 (2016), 241–279.

[29] Luce Drouet, Wo Meijer, Aisling Ann O'Kane, Aneesha Singh, Thiemo Wambsganss, Andrea Mauri, and Himanshu Verma. 2023. The EmpathiCH Workshop: Unraveling Empathy-Centric Design. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI EA '23)*. Association for Computing Machinery, New York, NY, USA, Article 366, 7 pages. https://doi.org/10.1145/3544549.3573796

[30] Jon Elster. 2005. The market and the forum: three varieties of political theory. In *Debates in contemporary political philosophy*. Routledge, 335–351.
[31] Siamak Faridani, Ephrat Bitton, Kimiko Ryokai, and Ken Goldberg. 2010. Opinion Space: A Scalable Tool for Browsing Online Comments. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Atlanta, Georgia, USA) *(CHI '10)*. Association for Computing Machinery, New York, NY, USA, 1175–1184. https://doi.org/10.1145/1753326.1753502
[32] Franz Faul, Edgar Erdfelder, Axel Buchner, and Albert-Georg Lang. 2009. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior research methods* 41, 4 (2009), 1149–1160.
[33] B. J. Fogg. 2002. Persuasive Technology: Using Computers to Change What We Think and Do. *Ubiquity* 2002, December, Article 5 (dec 2002), 32 pages. https://doi.org/10.1145/764008.763957
[34] Dennis Friess and Christiane Eilders. 2015. A systematic review of online deliberation research. *Policy & Internet* 7, 3 (2015), 319–339.
[35] Chris D Frith and Tania Singer. 2008. The role of social cognition in decision making. *Philosophical Transactions of the Royal Society B: Biological Sciences* 363, 1511 (2008), 3875–3886.
[36] Mingkun Gao, Hyo Jin Do, and Wai-Tat Fu. 2018. Burst Your Bubble! An Intelligent System for Improving Awareness of Diverse Social Opinions. In *23rd International Conference on Intelligent User Interfaces* (Tokyo, Japan) *(IUI '18)*. Association for Computing Machinery, New York, NY, USA, 371–383. https://doi.org/10.1145/3172944.3172970
[37] John Gastil, Peter Levine, et al. 2005. *The deliberative democracy handbook: Strategies for effective civic engagement in the twenty-first century*. Jossey-Bass.
[38] Bertram Gawronski and Galen V Bodenhausen. 2006. Associative and propositional processes in evaluation: an integrative review of implicit and explicit attitude change. *Psychological bulletin* 132, 5 (2006), 692.
[39] Connie Golsteijn, Sarah Gallacher, Licia Capra, and Yvonne Rogers. 2016. Sens-Us: Designing Innovative Civic Technology for the Public Good. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems* (Brisbane, QLD, Australia) *(DIS '16)*. Association for Computing Machinery, New York, NY, USA, 39–49. https://doi.org/10.1145/2901790.2901877
[40] Connie Golsteijn, Sarah Gallacher, Lisa Koeman, Lorna Wall, Sami Andberg, Yvonne Rogers, and Licia Capra. 2015. VoxBox: A Tangible Machine that Gathers Opinions from the Public at Events. In *Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '15)*. Association for Computing Machinery, New York, NY, USA, 201–208. https://doi.org/10.1145/2677199.2680588
[41] Jarod Govers, Eduardo Velloso, Vassilis Kostakos, and Jorge Goncalves. 2024. AI-Driven Mediation Strategies for Audience Depolarisation in Online Debates. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–18.
[42] Eduardo Graells-Garrido, Mounia Lalmas, and Ricardo Baeza-Yates. 2016. Data Portraits and Intermediary Topics: Encouraging Exploration of Politically Diverse Profiles. In *Proceedings of the 21st International Conference on Intelligent User Interfaces* (Sonoma, California, USA) *(IUI '16)*. Association for Computing Machinery, New York, NY, USA, 228–240. https://doi.org/10.1145/2856767.2856776
[43] Colin M Gray, Yubo Kou, Bryan Battles, Joseph Hoggatt, and Austin L Toombs. 2018. The dark (patterns) side of UX design. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–14.
[44] Robert H. 1990. *Robert's rules of order newly revised*. Perseus Books.
[45] Juho Hamari and Jonna Koivisto. 2013. Social motivations to use gamification: An empirical study of gamifying exercise. In *ECIS 2013 - Proceedings of the 21st European Conference on Information Systems*.
[46] Lobna Hassan and Juho Hamari. 2019. Gamification of E-Participation: A Literature Review. In *Proceedings of the 52nd Hawaii International Conference on System Sciences*. HICSS. https://doi.org/10.24251/HICSS.2019.372
[47] Lobna Hassan and Juho Hamari. 2020. Gameful civic engagement: A review of the literature on gamification of e-participation. *Government Information Quarterly* 37, 3 (2020), 101461.
[48] Yen-Chia Hsu, Paul Dille, Jennifer Cross, Beatrice Dias, Randy Sargent, and Illah Nourbakhsh. 2017. Community-Empowered Air Quality Monitoring System. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 1607–1619. https://doi.org/10.1145/3025453.3025853
[49] Yen-Chia Hsu and Illah Nourbakhsh. 2020. When human-computer interaction meets community citizen science. *Commun. ACM* 63, 2 (2020), 31–34.
[50] Renee A Irvin and John Stansbury. 2004. Citizen participation in decision making: is it worth the effort? *Public administration review* 64, 1 (2004), 55–65.
[51] Sebastian Jabbusch. 2011. *Liquid Democracy in der Piratenpartei: Eine neue Chance für innerparteiliche Demokratie im 21. Jahrhundert?, Universität Greifswald*. Ph. D. Dissertation. Diplomarbeit.

[52] Martin Karlsson. 2010. What does it take to make online deliberation happen?: A comparative analysis of 28 online discussion forums. In *Fourth international conference on Online deliberation, OD2010, Leeds, UK, June 30–July 2, 2010*. University of Leeds, 142–156.

[53] Geoff Kaufman, Mary Flanagan, and Max Seidman. 2021. *Creating stealth game interventions for attitude and behavior change: An 'embedded design' model*. Amsterdam University Press, Chapter 5, 73–90.

[54] Raymond Kight and Sandra Burri Gram-Hansen. 2019. Do ethics matter in persuasive technology?. In *International Conference on Persuasive Technology*. Springer, 143–155.

[55] Hae-Young Kim. 2017. Statistical notes for clinical researchers: Chi-squared test and Fisher's exact test. *Restorative dentistry & endodontics* 42, 2 (2017), 152.

[56] Nuri Kim. 2016. Beyond rationality: The role of anger and information in deliberation. *Communication Research* 43, 1 (2016), 3–24.

[57] Soomin Kim, Jinsu Eun, Joseph Seering, and Joonhwan Lee. 2021. Moderator chatbot for deliberative discussion: Effects of discussion structure and discussant facilitation. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW1 (2021), 1–26.

[58] Joel Kiskola, Thomas Olsson, Heli Väätäjä, Aleksi H. Syrjämäki, Anna Rantasila, Poika Isokoski, Mirja Ilves, and Veikko Surakka. 2021. Applying Critical Voice in Design of User Interfaces for Supporting Self-Reflection and Emotion Regulation in Online News Commenting. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 88, 13 pages. https://doi.org/10.1145/3411764.3445783

[59] Mark Klein and Luca Iandoli. 2008. Supporting collaborative deliberation using a large-scale argumentation system: the MIT collaboratorium. *MIT Sloan School of Management Working Paper Series* 4691-08 (2008), 10 pages.

[60] Olga M Klimecki, Matthieu Vétois, and David Sander. 2020. The impact of empathy and perspective-taking instructions on proponents and opponents of immigration. *Humanities and Social Sciences Communications* 7, 1 (2020), 1–12.

[61] Eva Krick. 2022. Citizen experts in participatory governance: Democratic and epistemic assets of service user involvement, local knowledge and citizen science. *Current Sociology* 70, 7 (2022), 994–1012.

[62] Travis Kriplean, Jonathan Morgan, Deen Freelon, Alan Borning, and Lance Bennett. 2012. Supporting Reflective Public Thought with Considerit. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work* (Seattle, Washington, USA) *(CSCW '12)*. Association for Computing Machinery, New York, NY, USA, 265–274. https://doi.org/10.1145/2145204.2145249

[63] Travis Kriplean, Michael Toomim, Jonathan Morgan, Alan Borning, and Amy J. Ko. 2012. Is This What You Meant? Promoting Listening on the Web with Reflect. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Austin, Texas, USA) *(CHI '12)*. Association for Computing Machinery, New York, NY, USA, 1559–1568. https://doi.org/10.1145/2207676.2208621

[64] Nojin Kwak, Daniel S Lane, Slgi S Lee, Fan Liang, and Brian E Weeks. 2021. From persuasion to deliberation: Do experiences of online political persuasion facilitate dialogic openness? *Communication research* 48, 5 (2021), 642–664.

[65] Hélène Landemore. 2012. *Democratic reason: Politics, collective intelligence, and the rule of the many*. Princeton University Press.

[66] Min Kyung Lee, Daniel Kusbit, Evan Metsky, and Laura Dabbish. 2015. Working with Machines: The Impact of Algorithmic and Data-Driven Management on Human Workers. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 1603–1612. https://doi.org/10.1145/2702123.2702548

[67] Bruno Lepri, Jacopo Staiano, David Sangokoya, Emmanuel Letouzé, and Nuria Oliver. 2017. The tyranny of data? the bright and dark sides of data-driven decision-making for social good. In *Transparent data mining for big and small data*. Springer, 3–24.

[68] Weichen Liu, Sijia Xiao, Jacob T. Browne, Ming Yang, and Steven P. Dow. 2018. ConsensUs: Supporting Multi-Criteria Group Decisions by Visualizing Points of Disagreement. *Trans. Soc. Comput.* 1, 1, Article 4 (jan 2018), 26 pages. https://doi.org/10.1145/3159649

[69] Jiahao Lu, Alejandra Gomez Ortega, Milene Gonçalves, and Jacky Bourgeois. 2021. The Impact of Data on the Role of Designers and their Process. *Proceedings of the Design Society* 1 (2021), 3021–3030.

[70] Guillermo Macbeth, Eugenia Razumiejczyk, and Rubén Daniel Ledesma. 2011. Cliff's Delta Calculator: A non-parametric effect size program for two groups of observations. *Universitas Psychologica* 10, 2 (2011), 545–555.

[71] Tambiama Madiega and Anne Louise Van De Pol. 2022. *Artificial Intelligence Act and Regulatory Sandboxes*. Technical Report PE 733.544. European Parliamentary Research Service, European parliament. 6 pages. https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733544/EPRS_BRI(2022)733544_EN.pdf

[72] Pia Mancini. 2015. Why it is time to redesign our political system. *European View* 14, 1 (June 2015), 69–75. https://doi.org/10.1007/s12290-015-0343-9

[73] Andrea Mauri, Yen-Chia Hsu, Marco Brambilla, Ting-Hao Kenneth Huang, Aisling Ann O'Kane, and Himanshu Verma. 2022. Empathy-Centric Design At Scale. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI EA '22)*. Association for Computing Machinery, New York, NY, USA, Article 75, 6 pages. https://doi.org/10.1145/3491101.3503744

[74] John H McDonald. 2014. *Handbook of biological statistics (3rd ed.)*. Vol. 2. sparky house publishing Baltimore, MD (https://www.biostathandbook.com/).

[75] Shlomo Mizrahi, Nissim Cohen, Eran Vigoda-Gadot, and Dana Natan Krup. 2023. Compliance with government policies during emergencies: Trust, participation and protective actions. *Governance* 36, 4 (2023), 1083–1102.

[76] George O Mohler, Martin B Short, P Jeffrey Brantingham, Frederic Paik Schoenberg, and George E Tita. 2011. Self-exciting point process modeling of crime. *J. Amer. Statist. Assoc.* 106, 493 (2011), 100–108.

[77] Sean A. Munson and Paul Resnick. 2010. Presenting Diverse Political Opinions: How and How Much. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Atlanta, Georgia, USA) *(CHI '10)*. Association for Computing Machinery, New York, NY, USA, 1457–1466. https://doi.org/10.1145/1753326.1753543

[78] Lala Muradova and Kevin Arceneaux. 2022. Reflective political reasoning: Political disagreement and empathy. *European Journal of Political Research* 61, 3 (2022), 740–761.

[79] Julian A Nasello, Benoit Dardenne, Adélaïde Blavier, and Jean-Marc Triffaux. 2023. Does empathy predict decision-making in everyday trolley-like problems? *Current Psychology* 42, 4 (2023), 2966–2979.

[80] Michael A Neblo. 2007. *Change for the better? Linking the mechanisms of deliberative opinion change to normative theory*. Cambridge University Press, Chapter 6, 1 – 32.

[81] Matti Nelimarkka. 2019. A review of research on participation in democratic decision-making presented at SIGCHI conferences. Toward an improved trading zone between political science and HCI. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–29.

[82] Harri Oinas-Kukkonen and Marja Harjumaa. 2009. Persuasive systems design: Key issues, process model, and system features. *Communications of the association for Information Systems* 24, 1 (2009), 28.

[83] Rita Orji, Derek Reilly, Kiemute Oyibo, and Fidelia A Orji. 2019. Deconstructing persuasiveness of strategies in behaviour change systems using the ARCS model of motivation. *Behaviour & Information Technology* 38, 4 (2019), 319–335.

[84] Victoria Palacin, Síle Ginnane, Maria Angela Ferrario, Ari Happonen, Annika Wolff, Sara Piutunen, and Niina Kupiainen. 2019. SENSEI: Harnessing Community Wisdom for Local Environmental Monitoring in Finland. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI EA '19)*. Association for Computing Machinery, New York, NY, USA, 1–8. https://doi.org/10.1145/3290607.3299047

[85] Victoria Palacin, Matti Nelimarkka, Pedro Reynolds-Cuéllar, and Christoph Becker. 2020. The design of pseudo-participation. In *Proceedings of the 16th Participatory Design Conference 2020-Participation (s) Otherwise-Volume 2*. Association for Computing Machinery, New York, NY, USA, 40–44.

[86] Philip A. Powell and Jennifer Roberts. 2017. Situational determinants of cognitive, affective, and compassionate empathy in naturalistic digital interactions. *Computers in Human Behavior* 68 (2017), 137–148. https://doi.org/10.1016/j.chb.2016.11.024

[87] Vassilis Prevelakis and Diomidis Spinellis. 2001. Sandboxing Applications.. In *USENIX Annual Technical Conference, FREENIX Track*. Citeseer, 119–126.

[88] Ivana Quinto, Luca Iandoli, Anna De Liddo, et al. 2021. Designing Online Collaboration for the Individual and Social Good: A Collective Argumentation Approach.. In *AMCIS*. Association for Information Systems, 11 pages.

[89] Thomas Zoëga Ramsøy, Martin Skov, Julian Macoveanu, Hartwig R Siebner, and Toke Reinholt Fosgaard. 2015. Empathy as a neuropsychological heuristic in social decision-making. *Social Neuroscience* 10, 2 (2015), 179–191.

[90] Jan B Rosen, Matthias Brand, and Elke Kalbe. 2016. Empathy mediates the effects of age and sex on altruistic moral decision making. *Frontiers in Behavioral Neuroscience* 10 (2016), 67.

[91] Shawn W Rosenberg. 2007. *Deliberation, participation and democracy*. Springer.

[92] Kathleen Van Royen, Karolien Poels, Heidi Vandebosch, and Bieke Zaman. 2022. Think Twice to be Nice? A User Experience Study on a Reflective Interface to Reduce Cyber Harassment on Social Networking Sites. *International Journal of Bullying Prevention* 4, 1 (2022), 23–34.

[93] Ann C Rumble, Paul AM Van Lange, and Craig D Parks. 2010. The benefits of empathy: When empathy may sustain cooperation in social dilemmas. *European Journal of Social Psychology* 40, 5 (2010), 856–866.

[94] Richard M Ryan and Edward L Deci. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist* 55, 1 (2000), 68.

[95] Nicole J Saam. 2018. Recognizing the emotion work in deliberation. Why emotions do not make deliberative democracy more democratic. *Political Psychology* 39, 4 (2018), 755–774.

[96] Martin Saveski, Nabeel Gillani, Ann Yuan, Prashanth Vijayaraghavan, and Deb Roy. 2022. Perspective-taking to reduce affective polarization on social media. In *Proceedings of the International AAAI Conference on Web and Social*

*Media*, Vol. 16. Association for the Advancement of Artificial Intelligence, 885–895.

[97] Douglas Schuler. 2009. Online civic deliberation with e-liberate. In *Online deliberation: Design, research, and practice*, Vol. 2. CSLI Publications Stanford, CA, 293–302.

[98] Joseph Seering, Tianmi Fang, Luca Damasco, Mianhong'Cherie' Chen, Likang Sun, and Geoff Kaufman. 2019. Designing user interface elements to improve the quality and civility of discourse in online commenting behaviors. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–14.

[99] Froukje Sleeswijk Visser, Remko Van Der Lugt, and Pieter Jan Stappers. 2007. Sharing User Experiences in the Product Innovation Process: Participatory Design Needs Participatory Communication. *Creativity and Innovation Management* 16, 1 (2007), 35–45. https://doi.org/10.1111/j.1467-8691.2007.00414.x arXiv:https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-8691.2007.00414.x

[100] Anne Spaa, Abigail Durrant, Chris Elsden, and John Vines. 2019. Understanding the Boundaries between Policymaking and HCI. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3290605.3300314

[101] Hans Stiegler and Menno D. T. de Jong. 2015. Facilitating personal deliberation online: Immediate effects of two ConsiderIt variations. *Computers in Human Behavior* 51 (Oct. 2015), 461–469. https://doi.org/10.1016/j.chb.2015.05.018

[102] Nick Taylor, Justin Marshall, Alicia Blum-Ross, John Mills, Jon Rogers, Paul Egglestone, David M. Frohlich, Peter Wright, and Patrick Olivier. 2012. Viewpoint: empowering communities with situated voting devices. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12)*. Association for Computing Machinery, New York, NY, USA, 1361–1370. https://doi.org/10.1145/2207676.2208594

[103] R.H. Thaler and C.R. Sunstein. 2008. *Nudge: Improving Decisions about Health, Wealth, and Happiness*. Yale University Press. https://books.google.nl/books?id=dSJQn8egXvUC

[104] Sarah-Kristin Thiel. 2016. Reward-based vs. social gamification: Exploring effectiveness of gamefulness in public participation. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction*. Association for Computing Machinery, New York, NY, USA, 1–6.

[105] Sarah-Kristin Thiel, Titiana Petra Ertiö, and Matthias Baldauf. 2017. Why so serious? The Role of Gamification on Motivation and Engagement in e-Participation. *IxD&A* 35 (2017), 158–181.

[106] Sarah-Kristin Thiel and Peter Fröhlich. 2017. Gamification as motivation to engage in location-based public participation?. In *Progress in location-based services 2016*. Springer, 399–421.

[107] Kenneth W Thomas and Ralph H Kilmann. 1978. Comparison of four instruments measuring conflict behavior. *Psychological reports* 42, 3_suppl (1978), 1139–1145.

[108] A. Tocchetti and M. Brambilla. 2020. A gamified crowdsourcing framework for data-driven co-creation of policy making and social foresight. *CEUR Workshop Proceedings* 2736 (2020), 34–44. http://ceur-ws.org/Vol-2736/paper6.pdf

[109] Jameson L Toole, Nathan Eagle, and Joshua B Plotkin. 2011. Spatiotemporal correlations in criminal offense records. *ACM Transactions on Intelligent Systems and Technology (TIST)* 2, 4 (2011), 1–18.

[110] Julio Torales, Marcelo O'Higgins, João Mauricio Castaldelli-Maia, and Antonio Ventriglio. 2020. The outbreak of COVID-19 coronavirus and its impact on global mental health. *International journal of social psychiatry* 66, 4 (2020), 317–320.

[111] W Ben Towne and James D Herbsleb. 2012. Design considerations for online deliberation systems. *Journal of Information Technology & Politics* 9, 1 (2012), 97–115.

[112] Matthias Trénel. 2004. *Measuring the deliberativeness of online discussions. Coding scheme 2.4*. Technical Report. Social Science Research Center Berlin.

[113] Nina Valkanova, Robert Walter, Andrew Vande Moere, and Jörg Müller. 2014. MyPosition: sparking civic discourse by a public interactive poll visualization. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing (CSCW '14)*. Association for Computing Machinery, New York, NY, USA, 1323–1332. https://doi.org/10.1145/2531602.2531639

[114] Eric J Vanman. 2016. The role of empathy in intergroup relations. *Current Opinion in Psychology* 11 (2016), 59–63.

[115] Alberto Vanolo. 2018. Cities and the politics of gamification. *Cities* 74 (2018), 320–326. https://doi.org/10.1016/j.cities.2017.12.021

[116] Ilse Verdiesen, Martijn Cligge, Jan Timmermans, Lennard Segers, Virginia Dignum, and Jeroen van den Hoven. 2016. MOOD: Massive Open Online Deliberation Platform-A Practical Application.. In *EDIA@ ECAI*. IOS Press, 4–9.

[117] Himanshu Verma, Jakub Mlynář, Camille Pellaton, Matteo Theler, Antoine Widmer, and Florian Evéquoz. 2021. "WhatsApp in Politics?!": Collaborative Tools Shifting Boundaries. In *Human-Computer Interaction – INTERACT 2021 (Lecture Notes in Computer Science)*, Carmelo Ardito, Rosa Lanzilotti, Alessio Malizia, Helen Petrie, Antonio Piccinno, Giuseppe Desolda, and Kori Inkpen (Eds.). Springer International Publishing, Cham, 655–677. https://doi.org/10.1007/978-3-030-85623-6_37

[118] Froukje Sleeswijk Visser, Pieter Jan Stappers, Remko Van der Lugt, and Elizabeth BN Sanders. 2005. Contextmapping: experiences from practice. *CoDesign* 1, 2 (2005), 119–149.

[119] Scott Wright. 2012. Politics as usual? Revolution, normalization and a new agenda for online deliberation. *New media & society* 14, 2 (2012), 244–261.

[120] Shun Yi Yeo, Gionnieve Lim, Jie Gao, Weiyu Zhang, and Simon Tangi Perrault. 2024. Help Me Reflect: Leveraging Self-Reflection Interface Nudges to Enhance Deliberativeness on Online Deliberation Platforms. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–32.

## A Preliminary Evaluation of the Policy-Sandboxing Tool

In this preliminary study, we adopt a light ethnographic observation approach to understand how our tool can be used in a teaching environment to facilitate idea brainstorming (with the approval of our Human Research Ethics Committee). The study involved engaging students in a design studio, which is part of a course where students need to deliver a data-driven solution for urban challenges related to health, mobility, sustainability, and tourism. The objective of the design studio was to explore and brainstorm initial concepts for the solution. We chose the design studio setting since it resembles the situation when citizens brainstorm potential policy solutions to address urban challenges. One author of this paper conducted this study while being the design studio coach to observe how students worked with the tool. This is not a controlled experiment, and thus, we did not ask students to act like study participants.

The design studio consisted of 25 second-year industrial design Bachelor students, organized into five groups of five students each. The gender distribution was roughly equal. Each group was tasked with producing a 200-word text that described the challenges, topics of interest, and the data necessary to support the design process in addressing these challenges.

The structure of the studio followed a think-pair-share approach; students were first asked to come up with individual ideas, then discuss the ideas with their neighbors, and finally share the ideas with the entire classroom. Students were required to consider multiple perspectives, including those of policy-makers and citizens, by expressing their opinions and discussing the collected perspectives. A scenario was set up using the tool, with questions related to urban challenges.

At the beginning of the studio, the researcher introduced the tool, and all students were asked to individually answer a questionnaire for 15 minutes on the platform.

The questionnaire includes the following questions, and each answer is limited to 500 characters.

(1) What are the societal challenges that you are interested in (health, sustainability, mobility, or tourism)?
(2) What topics do you want to explore and are related to the challenges you picked (for example, water pollution for the sustainability challenge)?
(3) For the topics of the challenges that you pick, what data can help you design solutions, including problem framing, concept generation, artifact creation, result validation (for example, sensor data for water pollution)?
(4) What are your learning expectations about what you would like to learn about data?

After all the students submitted the answers, the researcher instructed students to take 15 minutes to read all submitted answers and discuss the answers with their neighbors. After that, the researcher put the learning expectations that students submitted on the large screen in the workshop room and went through all the points and questions. Then, the researcher asked students to take 15 minutes to start the group discussion of the challenges. After that, there is a 15-minute break.

When the students came back from the break, the researcher asked students to take 15 minutes to use the tool to create visions (image with caption) related to their group's chosen urban challenge

using the tool. The researcher demonstrated how to explore other users' visions within the tool. Next, students were instructed to work in interactive discussions to brainstorm ideas within their groups based on the content that others submitted using the tool. Students were given the freedom to choose their preferred ways of sketching ideas, such as a a digital whiteboard (e.g., Miro), pen-and-paper, or a combination of these two with our tool. Thirty minutes before the class ended, the researcher asked students to start writing the 200-word text.

The researcher talked to students in each group during the final 30 minutes. Based on the ethnographic observations rom the researcher, students had no difficulties using the tool to submit their answers using the platform; all groups submitted answers and created visions. Approximately 50% of the students opened the tool while submitting their answers and used it to support their discussions with group members. However, during the group brainstorming stage, the percentage of participants using the tool dropped to around 20%. Interestingly, most groups that used pen and paper had the tool open during the brainstorming session, while this was not the case for groups using Miro. After being instructed by the coach to create visions using the tool, about 30% of the participants chose to do so. Notably, one group showed frequent engagement with the tool, and one student within that group actively played many guessing games without specific instructions from the coach. The student expressed emotions explicitly when guessing the mood correctly or incorrectly.

The ethnographic observation revealed two key findings. First, students who used pen and paper for brainstorming tended to use our tool more often than those using digital whiteboards. However, it remains unclear whether this was due to our tool's effectiveness or the need to switch between different browser tabs when using a digital whiteboard. Future studies should explore how our tool can be integrated into existing design and decision-making processes. Second, during the "share" phase, where students engaged in discussions and idea-sharing, our tool received less attention compared to the "think" and "pair" phases. This could be attributed to students' concentration on discussions using multiple tools (e.g., pen-and-paper with our tool) at the same time. Additionally, while the content generation phase was well-designed, showing the decision-makers' perspective in our tool is still under development. Future studies should investigate ways to enhance the system's support for the entire brainstorming process.

## B Informed Consent

Below is the informed consent that we present to the users before the study.

### B.1 Researchers

This part contains the list of research names with email addresses.

### B.2 Purpose of the study

You are being invited to participate in a research study from [anonymous institution]. Participation is limited to adults (18 years of age and older). The purpose of this research study is to understand if our approach can effectively engage stakeholders in discussions of societal issues at scale. This study will take you approximately 15 minutes to complete. The data will be used to derive empirical design implications that can guide the development of our citizen engagement tool.

### B.3 Study procedure

You will use a web-based tool to provide opinions about predefined scenarios and interact with other people's opinions. At the beginning and the end of the study, you may be asked to fill out surveys. Please avoid putting personal identifiers in the web-based tool and survey.

### B.4 Benefits and risks of participation

The risks associated with participation in this study are no greater than those ordinarily encountered in daily life or during other online activities. There may be no direct benefit to you. However, the research result that comes from your data can contribute knowledge to humanity.

### B.5 Procedures for withdrawal from the study

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any question.

### B.6 Data collection and processing

We will not collect personal identifiers. When you interact with our tool, it will collect system usage data anonymously. We will process the anonymous data you contribute to the web-based tool and surveys. Your user ID (returned by the crowdsourcing platform) will be anonymized (by assigning an unidentifiable ID like a random string) as soon as possible. The raw demographic data that you provide will be deleted after the research is done. Only the aggregated demographic data will be kept. Since all data are anonymized, it is impossible to retract your data after the study is done.

### B.7 Data usage and privacy

The analysis results and the data collection methodology may be published in research papers or technical reports. We will aim for open access publication. During the active phase of research, the project leader from [anonymous institution] will oversee the access rights to data (and other outputs), as well as any requests for access from external parties. Sharing of data with others will only be done in such a manner that subjects will not be identified. We will host data on password-protected storages.

### B.8 Research participant rights

If you have concerns or questions about this research study, or if you believe that you have been harmed due to participation in this study, please contact the researchers, listed at the beginning of this informed consent form.

### B.9 Provide your consent

I have read and understood the study information. I consent voluntarily to participate in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason. I understand that taking part in the study involves using a web-based tool and taking surveys. I understand that information I provide will be used for data analysis, and the anonymous data and the results may be released publicly in research papers or technical reports. I agree that the data I provided in the study can be quoted in research outputs. I give permission for the non-identifiable data that I provide to be archived into an anonymized dataset so it can be used for future research and learning.

- Please kindly let us know if you agree with all the above statements. We will only proceed if you answer YES.

## C Demographic Survey Questions

Below are the questions in the demographic survey and their corresponding options.

- What is your gender identity? [Female; Male; Non-binary/non-conforming; Transgender; Others; Prefer not to say]

- What is your age range? [18-24 years old; 25-34 years old; 35-44 years old; 45-54 years old; 55-64 years old; 65-74 years old; 75 years or older; Prefer not to say]
- What is your education level? [No formal educational credential; High school diploma or equivalent; Some college, no degree; Postsecondary nondegree award; Associate's degree; Bachelor's degree; Master's degree; Doctoral or professional degree; Prefer not to say]

## D Empathy Survey Questions

Below are the questions in the empathy survey that measures perspective taking and empathic concern. These questions are from the Interpersonal Reactivity Index questionnaire [24, 25]. Each question is answered on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

### D.1 Perspective Taking Questions

- [PT1] Before criticizing somebody, I try to imagine how I would feel if I were in their place.
- [PT2] If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
- [PT3] I sometimes try to understand my friends better by imagining how things look from their perspective.
- [PT4] I believe that there are two sides to every question and try to look at them both.
- [PT5] I sometimes find it difficult to see things from the other person's point of view.
- [PT6] I try to look at everybody's side of a disagreement before I make a decision.
- [PT7] When I'm upset at someone, I usually try to put myself in their shoes for a while.

### D.2 Empathic Concern Questions

- [EC1] When I see someone being taken advantage of, I feel kind of protective toward them.
- [EC2] When I see someone being treated unfairly, I sometimes don't feel very much pity for them.
- [EC3] I often have tender, concerned feelings for people less fortunate than me.
- [EC4] I would describe myself as a pretty soft-hearted person.
- [EC5] Sometimes I don't feel sorry for other people when they are having problems.
- [EC6] Other people's misfortunes do not usually disturb me a great deal.
- [EC7] I am often quite touched by things that I see happen.

### D.3 Quality Control Questions

Below are the reversed question checks for quality control in the empathy survey.

- [Reversed EC5] Sometimes I feel sorry for other people when they are having problems.
- [Reversed PT1] I do not try to imagine how I would feel if I were in somebody's place before criticizing them.

Below are the instructional manipulation checks for quality control in the empathy survey.

- Please select the option Strongly Agree from the list of choices below.

## E Post-study Survey Questions

Below are the questions in the post-study survey with 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

- Seeing other people's votes plays an important role in my decision.
- Seeing other people's motivations plays an important role in my decision.
- Seeing images in other people's motivations plays an important role in my decision.
- The tool has been easy to use.

Below are other questions and their corresponding options in the post-study survey.

- Have you used similar digital tools before? [Yes; No]
- Do you have any comments for this study (e.g., problems in using the digital tool)? [Open-ended question]

## F Roles

Below are the descriptions of the roles that are evenly and randomly assigned to the participants for choosing an opinion.

### F.1 Imagine you are a Bachelor Student

- You are a new Bachelor's student enrolled in Miskatonic University.
- You just moved into a dorm on campus.
- You still keep in touch with high-school friends who live close to the campus.
- You have a private room and a shared common area for socializing.
- You have a part-time job on campus to help with the tuition fees.

### F.2 Imagine you are a Master Student

- You are a new Master's student enrolled in Miskatonic University.
- You come from abroad, and you don't know anyone.
- You live in a shared apartment with the other three tenants.
- In this semester you have lessons 4 days a week, all starting at 9 am.
- After lectures, you like to study in the public spaces of the campus.

### F.3 Imagine you are a PhD Student

- You are a PhD student just enrolled in the graduate program of Miskatonic University.
- You have weekly meetings with your supervisor and with the other PhD candidates.
- While the university provided you with a working laptop, you still need to access some facilities on campus to carry out your work (e.g., using laboratory equipment).

### F.4 Imagine you are a Researcher

- You are a researcher working at Miskatonic University.
- Your duties mainly include conducting research, meeting with colleagues, and doing small teaching activities, such as coaching students.
- You don't require any specific facility to carry out your work, but you do like the desk, chair, and monitor provided by the university (and the free coffee).

### F.5 Imagine you are a Professor

- You are a professor working at Miskatonic University.
- Your duties on campus include attending meetings with both colleagues and students, teaching courses, and conducting research.
- During the past year, you learned how to use several software tools to carry out your work in a remote setting.

## G Motivations

Below are the pre-created motivations listed under each opinion, including both the text and the link to the image.

### G.1 The university should not allow people to work on campus, and all activities should be online.

- Home is the best place
(https://unsplash.com/photos/DUmFLtMeAbQ)
- Stay home, stay safe!
(https://unsplash.com/photos/HJgaV1qjHS0)
- I prefer working from home and not getting infected
(https://unsplash.com/photos/RvPDe41lYBA)
- Remote study for a better study.
(https://unsplash.com/photos/_jw7pZVwFrg)
- Safety first!
(https://unsplash.com/photos/7xmmnBTOATY)
- We've done this for the past 2 years, people are doing just fine.
(https://unsplash.com/photos/HF-WpYPeqZU)
- This is not the time to interact with other people
(https://unsplash.com/photos/DBiExzhMt3E)
- We shouldn't have lifted restrictions. This little maneuver's gonna cost us 51 years.
(https://unsplash.com/photos/R-EYaqOjhlo)

### G.2 The university should only allow fully vaccinated people to enter the campus.

- Enough with the social distancing
(https://unsplash.com/photos/GsuoClhxMDE)
- It's the only way
(https://unsplash.com/photos/IPe4SIIKuno)
- Vaccines and masks for a safe education.
(https://unsplash.com/photos/A44EW3n2PgM)
- Is this... Irresponsiblity?
(https://unsplash.com/photos/_mmronFYaMg)
- I believe in the science of the vaccine to protect us
(https://unsplash.com/photos/YCVUR2JgfHA)
- You get out and you get out! No-Vax get out!
(https://unsplash.com/photos/B1RsVgAoODU)
- Investing for a better future!
(https://unsplash.com/photos/7jjnJ-QA9fY)
- Vaccination is the way to get all of us out from lockdown
(https://unsplash.com/photos/69zVsGRejY4)

### G.3 The university should support the hybrid setting to enable both physical and virtual presence (for example, using scheduling systems or masks).

- Balanced as everything should be.
(https://unsplash.com/photos/YGBYROFge3c)
- Safety, Happiness, simply Schedule.
(https://unsplash.com/photos/18mUXUS8ksI)
- Sometimes I just want to stay home and not go to campus for education
(https://unsplash.com/photos/xKJUnFwfz3s)
- We have computers in our pockets, c'mon!
(https://unsplash.com/photos/_PoOFXAMy24)

- Freedom of choice
  (https://unsplash.com/photos/3iPKIXVXv_U)
- I want to work with my colleagues safely on campus with masks
  (https://unsplash.com/photos/LyF5jsdcYW0)
- Better than only ZOOM
  (https://unsplash.com/photos/smgTvepind4)
- One does not simply have a lab in their living room.
  (https://unsplash.com/photos/gKUC4TMhOiY)

### G.4 The university should only allow education activities on campus, and no other activities are allowed (e.g., social gatherings).

- Still better than nothing.
  (https://unsplash.com/photos/4nKOEAQaTgA)
- I love asking questions
  (https://unsplash.com/photos/Qs_Zkak27Jk)
- I do not want to learn alone at home (sad)
  (https://unsplash.com/photos/gH5yrgiw4Xw)
- Less teamwork = Worse performances.
  (https://unsplash.com/photos/hCb3lIB8L8E)
- I miss my colleagues
  (https://unsplash.com/photos/YloghyfD7e8)
- I miss both in-person education and social activities, but we should open things one at a time
  (https://unsplash.com/photos/QckxruozjRg)
- Ight imma head to class.
  (https://unsplash.com/photos/YRMWVcdyhmI)
- We should avoid useless gatherings.
  (https://unsplash.com/photos/cPWUODAvXjk)

### G.5 The university should allow people to work on campus without restrictions.

- A university is more than just lectures
  (https://unsplash.com/photos/z8XO8BfqpYc)
- Campus life is an important part of a university.
  (https://unsplash.com/photos/p85-MG66GRY)
- Finally a quiet place
  (https://unsplash.com/photos/e3Uy4k7ooYk)
- People know how to behave.
  (https://unsplash.com/photos/FN7pEVoDphc)
- Enjoy your life!
  (https://unsplash.com/photos/jI3PmZZscBs)
- Life is too short, let's go drinking!!!
  (https://unsplash.com/photos/W3SEyZODn8U)
- I hate lockdown when nothing is open
  (https://unsplash.com/photos/DGoWFMB1LM0)
- Back to a real life!
  (https://unsplash.com/photos/6bKpHAun4d8)

## H Additional Data from the Prolifc Study

Table 9. The tables below show participants' demographic information, including sex, age range, education, location when conducting the study, student status, and job status. Higher education means Associate's, Bachelor's, Master's, and Ph.D. degrees.

| **Sex/Age** | 18-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65-74 | 75+ | Sum |
|---|---|---|---|---|---|---|---|---|
| Female | 89 | 89 | 23 | 4 | 1 | 0 | 0 | 206 (49.0%) |
| Male | 92 | 84 | 27 | 5 | 5 | 1 | 0 | 214 (51.0%) |
| Sum | 181 (43.1%) | 173 (41.2%) | 50 (11.9%) | 9 (2.2%) | 6 (1.4%) | 1 (0.2%) | 0 (0%) | 420 (100%) |

| **Education** | Has a Higher Education Degree | Others |
|---|---|---|
| Count | 247 (58.8%) | 173 (41.2%) |

| **Location** | European Countries | South Africa | Other Countries |
|---|---|---|---|
| Count | 268 (63.8%) | 128 (30.5%) | 24 (5.7%) |

| **Student Status** | Is a Student | Not a Student |
|---|---|---|
| Count | 200 (47.6%) | 220 (52.4%) |

| **Job Status** | Has a Full-time Job | No Full-time job |
|---|---|---|
| Count | 172 (41.0%) | 248 (59.0%) |

Received July 2023; revised April 2024; accepted July 2024