PSEPHOS: ARTEFACT ECOLOGIES & PARTICIPATORY DESIGN OF PHYSICAL DATA REPRESENTATIONS FOR DELIBERATION

Host: Institut Mines Télécom (DIVA) / Inria (Aviz)

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1 CONTEXT AND RESEARCH QUESTIONS

This project studies the use of physical data representations to facilitate deliberation. An early example of deliberation appears on a 490 B.C. Greek wine cup, where citizens voted by dropping pebbles into an urn [1]. Contemporary efforts of deliberation include the Citizens' Convention for the Climate [2], a multi-session process proposing policies to cut France's carbon emissions. Although such processes can reinvigorate democratic practice [3] amid waning institutional trust [4], tools tailored for *in-situ* deliberation remain scarce. Many digital platforms aim at asynchronous participation but suffer from low engagement and accessibility barriers [5], especially for non-digitally literate participants. In synchronous sessions, digital tools are often haphazardly patched together with physical artefacts (maps, stickers, cards) without a clear strategy for diverse stakeholder agendas or for co-located vs. remote, synchronous vs. asynchronous use. To clarify how artefacts mediate collective deliberation and meaning-making, we analyse relationships among artefacts, people, and practices through the lens of computer-mediated collaborative dynamics [6], i.e., *artefact ecologies*. We will partner with Res Publica[1], an organisation with experience in planning and facilitating deliberation processes, to study the artefact ecologies used in their deliberation sessions.

We will then apply this ecological view to the research disciplines of information visualization and data physicalisation (DataPhys) [1, 7]. Despite a historical role in deliberation, DataPhys has only recently emerged as a research focus in visualization, with prior work emphasizing single-user desktop tools for weighing options rather than collective decision-making. Recent studies show DataPhys can let diverse participants input choices into a shared physical artefact [8], supporting collaborative reflection (e.g., dietary choices [9]) and sustainability dialogues at conferences [10]. We therefore hypothesize that computer-supported DataPhys can involve people with varied backgrounds, including digital novices, in co-located, collaborative data collection via simple physical actions [11], while also capturing data digitally for later analysis.

To test this hypothesis, we will co-design with Res Publica a computer-supported DataPhys toolkit that bridges physical and digital interaction for collective deliberations. This follows calls to involve stakeholders across planning, deployment, and dissemination to ensure transparent representations and equitable participation, especially for marginalized groups [12]. Combining artefact-ecology analysis with equity-oriented participatory design, we investigate:

RQ1 What artefacts and ecologies currently support deliberation?
RQ2 How can we co-create computer-supported physicalisation tools with deliberation organisers?
RQ3 How can findings from the ecology analysis and participatory design be operationalized into a toolkit that bridges physical and digital interactions?

The outputs of this project will create value both for the research community by creating knowledge on the use of data physicalisation in deliberation processes and for deliberation facilitators and society at large by providing new tools for real-time deliberation.

2 OBJECTIVES

By addressing these three research questions, this project analyses how computer-supported data physicalisation (DataPhys) can collect, record, and represent evolving trade-offs, opinions, positions, and arguments. In doing so, the project will produce representation models and processes for collective deliberation, which will ultimately inform and scale up collective representations of deliberation processes without reducing their quality. We operationalize the study with five objectives:

- **O1 – Artefact Ecology Analysis:** Investigate facilitators' and participants' experiences, tools, and workflows to surface information needs and guide visualization design. Observations and interviews will map artefact ecologies [6] across physical and digital tools, and inform appropriate representation models

[1] https://www.respublica-conseil.fr/

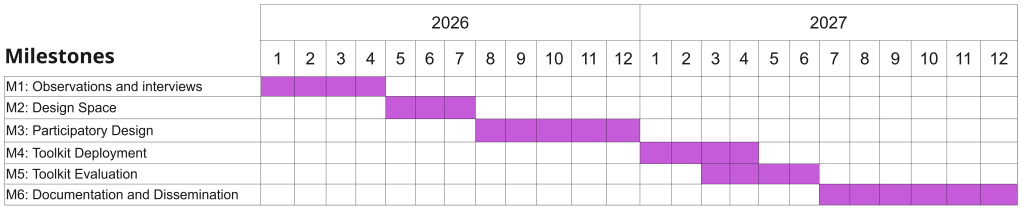

Figure 1: Project milestones proposed with a starting date of January 2026.

and processes for deliberation.

- **O2 – Design Space Survey:** Conduct a systematic survey of visual encodings and interaction mechanisms for deliberation to delineate the design space and generate guidance for **O3**.
- **O3 – Participatory Design of DataPhys Deliberation Toolkit:** Building on **O1–O2**, co-design an in-situ data physicalisation with stakeholders. With Res Publica, run ideation and brainstorming, iterate from low- to high-fidelity prototypes, and fabricate the final toolkit.
- **O4 – Evaluation of DataPhys Toolkit Impact:** Deploy the toolkit with a Res Publica client and evaluate its effects on the deliberation: interactions with the tools and impacts on process quality.
- **O5 – Reflection and Scale:** Examine how collective physical representations can scale to larger (including online) deliberations without sacrificing quality, while remaining critically attentive to each context's situated agendas and communities.

2.1 Challenges, Approach and Methods

We identify two challenges: data-driven and interaction-driven. The data-driven challenge is the ambiguity of deliberation data: captured data must reflect situated, negotiated meanings while enabling digitization for a priori analysis [8]. We will address this by collaborating with Res Publica – experienced in large-scale dialogues (e.g., the Citizens Convention for Climate [2]) – and by running a participatory design process to iteratively build the DataPhys toolkit. We will test tangible data-collection mechanisms for robust digital acquisition through co-design sessions (brainstorming, ideation, prototyping).

The interaction-driven challenge concerns how people engage physically with data during collective deliberation. Addressing it requires integrating participatory design and information visualization to decide what issues to represent, how to encode them, and how to scaffold continuous, collaborative interaction with the physicalisation artefact. We will deploy the DataPhys toolkit with a Res Publica client to evaluate its impact in a real deliberation. We will collect audio/video and conduct qualitative analysis [13] of deliberation quality, interactions with the toolkit, and the effects of externalizing opinions and arguments through physicalisation.

3 PROJECT ORGANISATION

The project, spanning two years (Fig. 1), aims to achieve its Objectives (Sec. 2) through milestones M1-M6:

- **M1** – Observation and analysis of deliberation (Res Publica, Telecom Paris IPP);
- **M2** – Formalization of the design space of DataPhys for deliberation at different scales (Telecom Paris IPP);
- **M3** – Participatory design and fabrication of the deliberation kit (Res Publica, Telecom Paris IPP);
- **M4** – Deployment via in-situ deliberation process with client (Res Publica, Telecom Paris IPP, INRIA);
- **M5** – Evaluation of the toolkit and deliberation process, and scale-up (Telecom Paris IPP, INRIA);
- **M6** – Creation of open-source online resources (Telecom Paris IPP, INRIA).

4 CONTRIBUTION, EXPECTED RESULTS AND IMPACT

This project contributes empirically, technically, and conceptually to human–computer interaction and information visualization. Empirically, it offers an artefact-ecology analysis of how deliberation organisers combine digital and physical tools, and reports findings from a participatory design process that co-creates and tests physicalisation tools for synchronous, co-located deliberation. Technically, it delivers a deliberation toolkit that uses computer-supported data physicalisation as a physical data-collection mechanism for digital interpretation. Conceptually, the project formalizes the design space of data physicalisation for deliberation, structuring the research terrain.

From an applicative perspective, we will co-design the toolkit with Res Publica and release documentation so that others can reproduce the procedure. The results support deliberation in local workshops, neighbourhood councils, and city-hall settings. As citizen collectives face more local decisions under changing conditions, accessible tools for collective deliberation can materially shape how future public decisions are organised.

5 POSITIONING IN THE ENSEMBLE PROGRAM

This research is situated at the intersection of data physicalisation [7] civic deliberation [14], and human-computer interaction [15]. This project connects to **PC4 CONGRATS** as we aim to 1) design and develop community-centred tools that support deliberation processes, 2) infrastructure computer-supported data physicalisation participation, and 3) study deliberation processes that include a large number of people. Projects from our partner, Res Publica, typically involve 30 to 150 people (as with the Citizen Convention for the Climate). We expect to explore the space of collective representations with tangible tools to understand how these activities might scale up so that our findings can inform other large-scale (online) deliberation processes. We position this research within **WP 4.4 Understanding socio-technical collaborative systems in action** and specifically the sub-task on **Public debate and platforms for citizen deliberation** as we aim to design new collaboration tools for public deliberation where we work together with facilitators in a PD process.

5.1 Project Partners

This project will bring together partners with complementary areas of expertise from information visualization (Inria), interaction Design (Télécom Paris), and deliberation experts (Res Publica). The host for this proposal is the DIVA (Design, Interaction, Visualization & Applications) group at Télécom Paris in collaboration with the Aviz team (Analysis and VIsualiZation) at Inria.

- **Advisor: Dr Nathalie Bressa (Télécom Paris, IPP)** is working on situated visualization and data physicalisation for deliberation and has a background in participatory design.
- **Advisor: Dr Samuel Huron (Télécom Paris, IPP)** is an interaction and data physicalisation expert and support the design, development, and implementation of the deliberation toolkit.
- **Advisor: Dr Petra Isenberg (Inria)** is an expert in collaborative visualization and will support visually representing the data in the deliberation process.
- **Project Partner: Sophie Guillain (Res Publica)** is an expert in organising collaborative dialogues and deliberation processes like the Citizens' Climate Convention and will be the partner in this project.

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