Patterns of Patterns II

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We review how our earlier theorization of pattern methods fares in the wild. The "wild" here included a graduate school classroom in New York, a workshop at a transdisciplinary conference in Arizona, a nascent citizen science project in Bristol, and a professional development day for a university in Oxford. We encountered unexpected challenges such as working with students in a HyFlex classroom, getting conference attendees to feel comfortable evaluating the conference they were presently attending, and adapting our plans on the fly when leading workshops with surprising attendee responses. We describe and refine pattern specifications that will help other practitioners of patterns in their own forays into the wild.

CCS Concepts: • **Social and professional topics**; • **Software and its engineering** → *Designing software*; *Open source model*; • **Applied computing** → *Operations research*; • **Computing methodologies** → Modeling and simulation;

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1 INTRODUCTION

Our paper "Patterns of Patterns" presented a high-level methodological synthesis of three techniques from design, futures studies, and learning management in the form of a design pattern called PLACARD [Corneli et al. 2021]. Since then, we have had opportunities to deploy and further develop these methods in various contexts. We will describe some of these applications in the four case studies below. We have distilled this experience into a collection of practical patterns which augment the earlier high-level PLACARD pattern. This fully-fledged collection of patterns of patterns can help you organize your work with Design Pattern Language methods.

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2 BACKGROUND

2.1 Recap of "Patterns of Patterns"

We introduced a synthesis of methods that operationalize the "sensory", "cognitive" and "motor" systems from psychology in the context of social intelligence. The particular methods we outlined were certainly not the only way to implement these system features. What drew our attention is that each of the methods we selected comes with a framework or template; each of the methods is, essentially, a design pattern.

- Project Action Review (PAR): *a set of five review questions to explore at a project checkpoint.*
- Causal Layered Analysis (CLA): *a set of four "layers" that can be used to unpack a problem area of interest.*
- Design Pattern Languages (DPL): *each constituent pattern follows a "Context/Problem/Solution" template.*

The Project Action Review is an adaptation of the After Action Review to horizontally-managed group work; the AAR has seen widespread use in military, business, and healthcare settings, and has proved to be an effective training approach in task environments that are characterized by a combination of high complexity and ambiguity [Keiser and Arthur 2021, 2022]. Causal Layered Analysis has been used for over thirty years by members of the futuring community to scaffold change-making initiatives [Inayatullah et al. 2022]. Design Pattern Languages are presumed to be well known to readers of this paper, and we offered a novel analysis of the pattern languages discourse in the prequel. There, we made the further assertion that these sensory, cognitive, and motor methods can be hooked together, theorizing design patterns as little pieces of moveable social intelligence. We called the specific method that combines PAR, CLA, and DPL the "PLACARD" pattern.

We applied these methods to analyze the design Pattern Language literature and practices, and also developed a case study examining the way the Emacs Research Group used related methods. We built on these analyzes to outline potential futures for the development of pattern methods.

2.2 Related work

Our work on this paper, and the prequel, progressed alongside the Peeragogy project.[1] Aspects of peeragogy were previously presented as design patterns [Corneli et al. 2015]. This paper focuses on a series of workshops that made our style of working accessible for "*Newcomer*s" to peeragogy. In these workshops, and in the workshop series as a whole, we co-created a context to study collaborative processes in microcosm.

The overall aim of this line of work to study and support social intelligence [Benkler et al. 2015], with a particular emphasis on learning aspects. Design patterns are a useful medium for this work. Iba and Isaku [2016] provide a large collection of patterns for creating patterns; and their threefold decomposition of the pattern language creation process, into mining (*a sensory activity*), writing (*a cognitive activity*), and symbolizing (*a motor activity*), bears an analogy with PLACARD. However, our aim is not to retrace Iba and Isaku's *Pattern Language Creation* pattern — though we do cross-reference their work at key junctures here. Rather, we descibe our own process of working with patterns with the aim of further developing our reconstruction of pattern theory.

Earlier authors, such as Moran [1971] and Oxman [1994], looked at the specifically-computational implementation of design pattern ideas. Computational considerations remain mostly in the background for us, as we focus on features of implementation at the social interaction and paper prototype level. We return to questions related to supportive computational implementation in the closing sections of this paper.

We will draw heuristic connections between design patterns and the active inference framework, a theory originating in theoretical neuroscience which "can be applied to explain the influential flows and dynamics of any open system at any scale" [Hipólito and van Es 2022]. Hipólito and van Es point out that patterns (when understood in a suitably general sense) are pre-linguistic, and are discovered and learned through bodily experience. The articulation of patterns in language supports a process of *niche construction*.

[1] https://peeragogy.org/

Towards this end, we embrace the often messy process of prototyping our way forward. "Making old walls serve for purposes for which they were not originally built" [Descartes 1850] is a suitable metaphor for this process. Whilst patterns have been thought of as a "living language" [Alexander et al. 1977, p. xvii] from the start, a well-articulated evolutionary perspective on pattern language development may be transformative at the practice level. (In particular, Löwy [2019, p. xxiii] notes that "no other industry [apart from software development!] opts for a clean slate on a regular basis simply because doing so does not make economic sense.")

3 METHODOLOGY

We ran three separate workshops that were inspired by the original set of PLACARD methods, and we will describe how the methods evolved further in those settings. We also used "Patterns of Patterns" as a focal reading over three sequential offerings of of a postgraduate course, CIS 9590 "Information Systems Development Project" at Baruch College, part of the City University of New York. We use experience reports, and Causal Layered Analysis [Inayatullah 1998], to develop a deep dive into that specific application. We also used of CLA as a tool in the other workshops, via a new visual template which bears some similarity to the "wholeness egg" of Iba and Munakata [2020].

In developing the workshops, our central methodological technique was to use design patterns—as design inputs, as in-workshop manipulatives, and as analytic outputs—in each of the workshops. A representative selection of these are included in this paper. Each of the patterns is given a marker, (s), (c), or (m), to indicate whether it plays a primarily sensory, cognitive, or motor role. We also include the itinerary for each of the workshops to help bring the reader into the scene.

We endeavor to show our process of pattern-development within the paper. As such, the paper includes a combination of patterns that follow a formal template, and proto-patterns, without substructure. The latter are distinguished by a "💎" marker, which evokes the concept of *pattern mining*. In our view, additional formality does not always help with communication. We endeavor to show how and when it is helpful. In Section 7, we give some examples which show how our Pattern Language Components can add structure to proto-patterns. Appendix A gives some further justification for including work at different levels of formality, with reference to Alexander [1964]. Some of the (proto-)patterns that we present here were created by workshop participants, rather than by the paper's coauthors, and these are distinguished by a "⛏️" marker.

For the patterns which are spelled out formally in the paper, we use this simple variation on the classical "Context Problem Solution" pattern template:

Context ...	[Summary of the working context]
If ... *BUT* ...	[A conflict, problem, or gap arising in this context]
Then ...	[Actions to take to resolve the conflict]

We use an intuitive alternative template structure to describe a sub-language of roles in Section 5. In the paper's subsections which focus on presenting patterns, additional narrative appears in an italic font.

We present the patterns that we developed and used in chronological order, insofar as this was possible in a retrospective reflection. In our iterative way of working, the workshop method itself becomes a kind of (complex) pattern, which we ran with variations. At each stage, input patterns play the role of lightweight hypotheses, structuring the experience and potentially being validated or invalidated by the interactions. As observed by Iba and Isaku [2016] the clear articulation of pattern-writing patterns helps to identify when patterns are used: but *not every pattern is used every time*. In our context, the survival of a given pattern to the next workshop (or not) gives a sense of the evolutionary character of the overall method. The methodological changes typically had a strategic rationale, and we aim to describe this in our commentary. We carefully reviewed the lessons learned after each workshop, either by using the Project Action Review template, or through less formal but

nevertheless detailed post mortems. Writing this paper is linked with that aspect of the method, since it provides the opportunity for review at a deeper rhythm.

If workshop development were our only aim, we would not have needed to write this paper at all. Miller [1988] outlines a general-purpose workshop design strategy. Other methods which we have encountered as workshop attendees include an adaptation of *sociocracy* [Rau and Koch-Gonzalez 2018], a strategy for collaboration that is distributed over nested 'circles', each of which makes decisions by consent (rather than consensus); and *theory of change* [Coryn et al. 2010], a method for articulating criteria for a project's success. General inspirations such as these are not commented on specifically in the text, though we are confident that they could be "patternized".

4 CASE STUDY 1: "GOING META" WORKSHOP AT ANTICIPATION 2022

This workshop functioned as a more developed pilot of methods that we shared at PLoP 2021 as "Flaws of the Cool City"[2] and at the Oxford Brookes Creative Industries Festival as "Dragon versus monkey: A kaijū introduction to peeragogy"[3] (and previously in more nascent forms). Our aims were both to introduce the methods to attendees, and to 'workshop' the methods. Our pitch was that we would help attendees establish a position of maximum leverage, exercising our "Critical Anticipatory Capacities" using "Creativity, Innovation and New Media" (two of the conference's themes) to explore the future of anticipation.

4.1 Input patterns

The workshop activities were presented to workshop attendees in the form of "pattern cards". A selection of these appear in Figure 1; several are detailed below, along with some more-abstract patterns which were written down after the fact, but which characterize the process that was used on the day. The full collection of cards shared with participants is available online.[4] *New cards were handed out for each phase of the workshop (for the itinerary, see Section 4.1.1), and were color-coded accordingly.*

DÉRIVE COMIX (s)

Context you want to develop some future scenarios to explore with a group.
If the group has been identified BUT the members don't know each other well yet, and accordingly each has their own separate experience, and the group has no concrete shared meanings;
Then Gather data. For example: go for a walk [Debord 1956], or just look out the window wherever you are. (Alternatively, close your eyes and conduct a mental exploration of your selected theme: what do you see in "your mind's eye?") Document what you see. Follow up by preparing your materials to share in a succinct fashion, e.g., as photos, a screenshot, slides, sketches, a zine, a map, or some PostIt® notes.

By itself, looking at the immediate surroundings only gives an imperfect picture of how to develop a future scenario. Direct observations might include little to no evidence of, say, top-level government policy which likely is a major factor in the future. Two further patterns work together to access more levels of meaning:

MEANING MAP (c)

Context We have collected images describing people's worlds (see Dérive Comics).
If you want to distill well-integrated shared understandings for the group BUT, so far, everyone has been keeping their experience, knowledge, and perspectives to themselves;
Then talk together about the problems and opportunities that everyone sees in the data that has been shared, and document any connections you find. Maybe some of the themes will cluster together. Maybe everyone will have wildly different perspectives: that's OK. You can use these different viewpoints to bring everyone on the same page: just document them as part of the map.

REINFUSE EXPERTISE (m)

Context a group wants to build a Meaning Map.
If everyone has experience as human being (and resident, citizen, etc.) BUT they also have some experience as an expert which is harder to share with non-experts;
Then begin by removing expertise to get everyone on the same page, and subsequently reinfuse expertise, to enable richer and more complex thinking.

[2] https://www.hillside.net/plop/2021/index.php?nav=program#focusgroups
[3] https://www.brookes.ac.uk/research/networks/creative-industries-research-and-innovation/festival-2021
[4] https://hyperreal.enterprises/open-future/

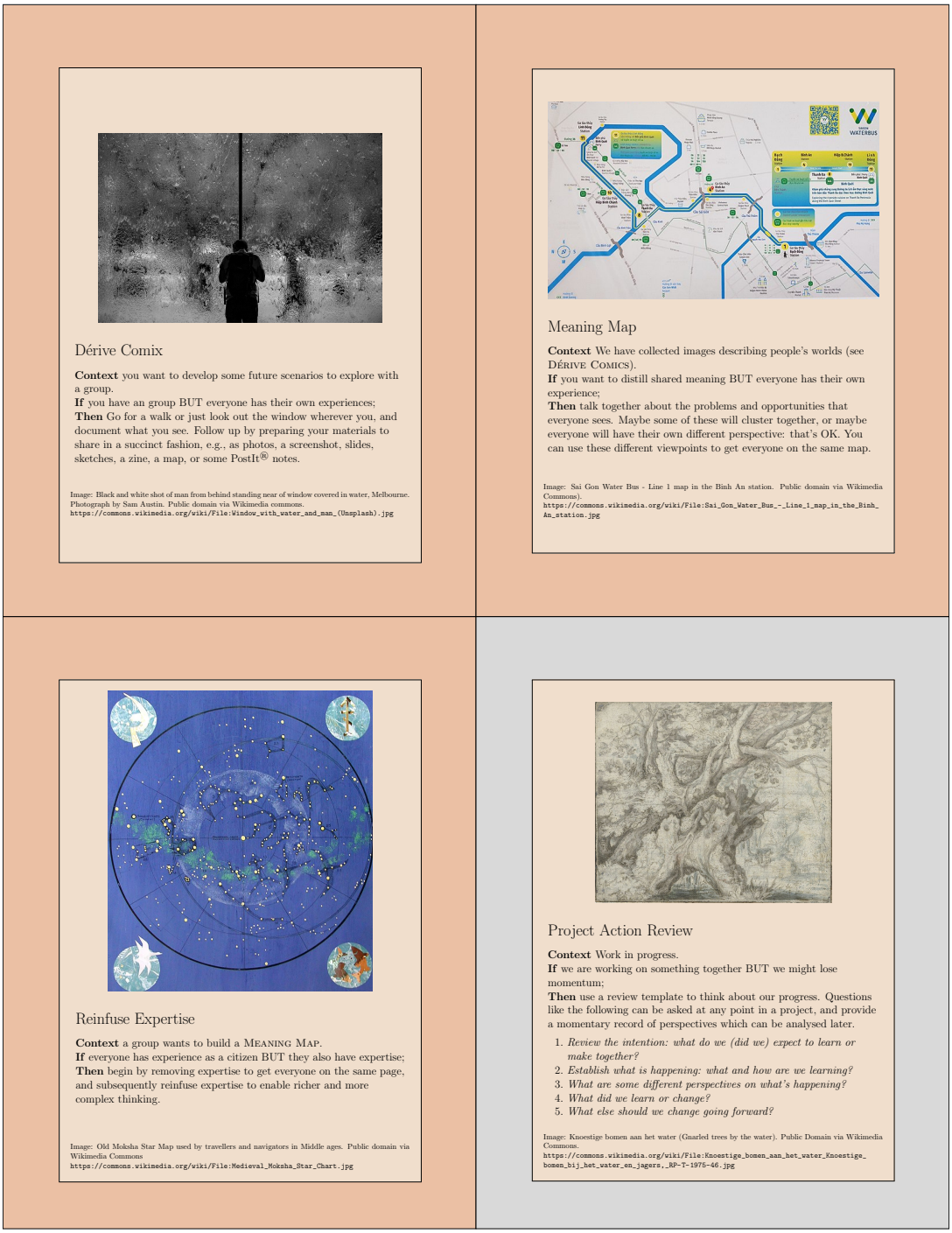

Fig. 1. A selection of the pattern cards we handed out to participants of the "Going Meta" workshop

The core process of informal sharing, map-making and sharing knowledge works well in small groups. A further level of meaning can be accessed by sharing the key findings from small groups.

SHARE BACK (s)

Context Members of sub-groups have shared their experiences with each other, and each sub-group has developed a Meaning Map
If we want to establish a meaning map for the whole group BUT unstructured interaction within the whole room is infeasible;
Then individual groups should present key findings to the room; or, alternatively, if the conversations are not yet at a natural stopping point ask the groups to pause their conversations and listen in briefly to the one of groups (in turn), who will continue their small-group conversation.

This nested process of sharing is intended to surface the core themes that the group finds important. In CLA terms, the contents of the Share Back *are key inputs for the Myth layer. A facilitated whole-group discussion of how these core themes fit together can yield a* Meaning Map *which expresses the group's shared Myth. At this point in the process, both the "zoomed out" whole-group map, and the "zoomed in" small-group maps are likely to contain 'optative' statements describing "the environment as we would like it to be" [Zave and Jackson 1997], potentially also including statements about what we wish not to have happen! These are the seeds of 'scenarios', though the details of these scenarios will only become apparent as they are explored. That happens in subsequent phases. The next two patterns describe the main tool we used to scaffold the exploration phase.*

PATTERN LANGUAGE COMPONENTS (c)

Context In a collaborative setting with people who are new to design patterns.
If attendees are being invited to create new design patterns that operationalize knowledge at the group level BUT the typical framing language of DPLs — which have 'conflict' at the core — is not comfortable for participants (e.g., because a 'problem' or 'conflict' is seen as a bad thing)
Then introduce and describe neutral keywords such as *HOWEVER* (which can variously be used to describe a gap, a conflict, an opportunity, or even a simple juxtaposition of facts), *BECAUSE* (to describe a set of operating causes), *THEREFORE* (to describe a rationale based on related data) , and *SPECIFICALLY* (to describe next steps), to help people build patterns piece by piece.

FUNCTIONAL ROLES (m)

Context When building a new set of design patterns.
If you have ideas about the components of a pattern BUT the pattern hasn't been fully formed yet.
Then introduce different perspectives to critique the pattern as it develops.

In our workshop at Anticipation 2022, we tried aligning the Pattern Language Components *with* Functional Roles*, as per "Phase II" in the Workshop Itinerary which follows (Section 4.1.1). However, in subsequent workshops, we decided to separate these two dimensions more distinctly. Further details on roles are given in the next Case Study (Section 5). In "Phase IV" of the Anticipation workshop, we carried out a Project Action Review together with participants, following the steps detailed both in the card we handed out at the start of that phase (lower-right of Figure 1) and in the itinerary. More general uses of the PAR are detailed in "Patterns of Patterns" [Corneli et al. 2021]. We note that within this workshop, its purpose was similar to the* Share Back *pattern, bringing together meanings at the group level once again. We had hoped that participants would come up with "next steps" that they would like to pursue themselves, but in fact, they used the opportunity primarily to share suggestions for us. Details of the feedback are available online.*[5]

[5] https://groups.google.com/g/peeragogy/c/V-knbZkwhB0

4.1.1 Workshop Itinerary.

What does the future hold for the anticipation community that we are part of?

Study Hall (5 minutes)

Participants take some time to review this itinerary.

Welcome (5 minutes)

We will briefly introduce design patterns and the workshop methodology and goals with the audience. Briefly, our goal is to help everyone here "go meta" and answer the thematic question above.

Phase I: Envisioning the future (20 minutes)

Groups review 4 cards in order. 1 | **Participatory Scenario Planning:** Get everyone on the same page: *today by using big sheets of paper*. 2 | **Dérive Comix** Bring data: *captioned mental images of "anticipation in action" (feel free to refer to photos on your phone).* 3 | **Meaning Map** Combine and structure the group's data in a network diagram, and cluster it around potentials for evolution. 4 | **Reinfuse Expertise** to enrich these scenarios, and add further structure to distinguish them (e.g., in terms of their value dimensions).

Phase II: Exploring the future (20 minutes)

Groups use 5 cards to structure a light-weight role-play. 1 | **Play to Anticipate the Future:** We use play to explore what the scenarios might be like: *grab another sheet of paper*. Each person should volunteer for a role. The roles are simple and conversational, and their purpose here is to help us find new patterns. Each role has control over a special word: 2 | **Kaiju Communicator** = "*however*", 3 | **Analyst** = "*because*", 4 | **Designer** = "*therefore*", and 5 | **Historian** = "*specifically*". If you want to swap roles, you can, if it's agreed.

Phase III: Enacting the future (20 minutes)

Groups will present the futures they developed and give a summary of their explorations. Other groups will have a brief chance to ask questions.

Phase IV: Project Action Review (or "PAR") (20 minutes)

We will work together with participants to build a **Roadmap** towards the desirable scenarios. We do this by carrying out a **PAR** of the activities we've done today, and structuring the next steps.

1. Review the intention: what did we expect to learn or make together?
2. Establish what is happening: what and how are we learning?
3. What are some different perspectives on what's happening?
4. What did we learn or change?
5. **What else should we change going forward?**

Phase V: *After the workshop*

Take action on the next steps we've gathered. Share progress via https://groups.google.com/g/peeragogy.

4.2 Intermediate artifacts

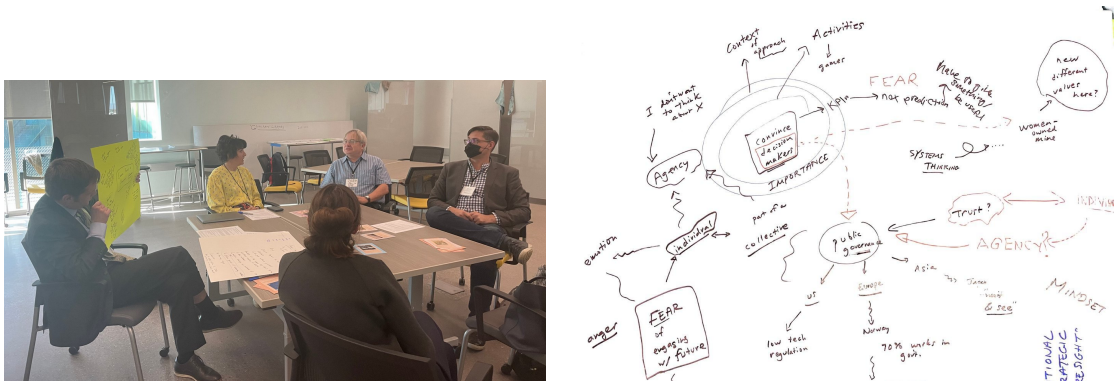

Fig. 2. In the workshop, participants used cards to structure discussions, and facilitators took notes and made diagrams.

Figure 2 shows the workshop in process (left) and details of the notes taken by one of the facilitators (right). Facilitators moved between facilitating small-group and whole-group activities. In the "Phase IV" review, participants had different responses to our request to reflect on the workshop's activities. Some considered the workshop to have led to good conversations, but doubted if the manipulatives and other structures helped. However, we observed that some participants had used the manipulatives in creative ways—such as asking each other to pass around the cards to better narrate the points they were making in the conversation. (This experience highlights the 'motor' aspect of the Functional Roles!) No new design patterns were generated on the day, but follow-up reflections on the experience did suggest some patterns.

4.3 Output patterns

The framing of our workshop relative to the Anticipation conference suggests a repeatable pattern:

GOING META (c)

Context In the course of working on a project together.
If we find a *gap* between our ideals and our methods;
Then Try "going meta", to explore how the project's methods can be applied to itself.
Example In a community that usually focuses on anticipating the future for others, try inviting members of the community to anticipate the future of the community itself.

Reflecting on the attendees' contributions, both in terms of their concrete comments about the Anticipation community as well as the way they interacted within the workshop (e.g., by contributing to note-taking and by leading conversations as the facilitators moved around the room) gave rise to the following proto-pattern:

💎 INCREASE PARTICIPANT CONTROL (m)

When organising a collaborative activity, participants should not remain only an audience, or only deliver scripted lines. Give them increasing responsibility.

Looking back at some remove, we can also notice a pattern that relates the work in this section to the paper:

💎 PILOT TO ANTICIPATE (s)

Invoking the Going Meta pattern, we reflect that our strategy of *piloting our workshop methods* was how we choose to anticipate the issues likely to arise in future iterations of the workshop. Perhaps the future of anticipation more widely will include the increased use of pilot schemes? In support of this possibility, Unger et al. [2019] have advocated for the enthusiastic embrace of "Experimental government".

4.4 Diagrammatic summary of the "PLACARD" process (and the "Open Future Design Workshop")

The diagram in Figure 3 shows how the new patterns like Going Meta and Increase Participant Control would be synthesized by following the PLACARD method, enlarging the "Pattern space" within a given domain. Notice that the "Going Meta" deployment of Open Future Design at Anticipation 2022 made explicit use of DPL and PAR, while only touching briefly on CLA. However, all three of the sensory, cognitive, and motor dimensions of PLACARD were brought into play with the patterns Dérive Comix, Meaning Map, and Functional Roles.

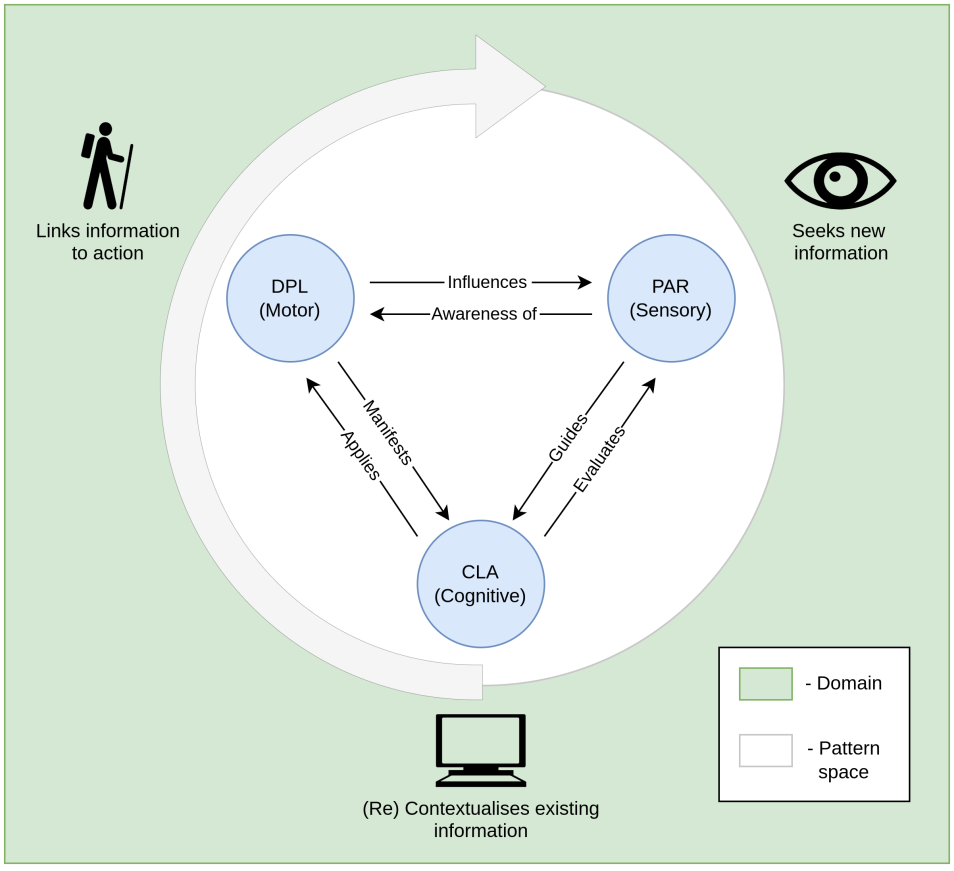

Fig. 3. Relationships between sensory, cognitive, and motor patterns (paralleling *MB Drawing a Map* from Iba and Isaku [2016]), here illustrating the potential for the space of patterns to grow as these methods are applied within a domain.

5 CASE STUDY 2: PUBLIC SPACE FOR PUBLIC HEALTH

This workshop was commissioned by co-author Abby Tabor as part of her research project at the University of the West of England on "Designing urban environments for human health: from the microbiome to the metropolis". The aim was to gather attendees with an interest in the project themes and work together to envision next steps. Elaborations of these were developed by participants, and were organized by facilitators using a software tool based on Org Roam and Org Roam UI.

Alongside the patterns from our Anticipation pilot, here looked for new methods to Increase Participant Control. In particular, we generated some further articulations of the Functional Roles that would help with this. The roles presented come with mnemonic symbols based on the chess set: at the workshop, participants were provided with additional physical manipulatives, i.e., the chess pieces that correspond to the symbols here, along with new pattern cards similar to those in Figure 1, featuring the descriptions here. As mentioned previously, in the Anticipation pilot, the roles were aligned with the Pattern Language Components. For example, previously the "Kaijū Communicator" role (here, renamed and adapted as the "Wrinkler") had final say over the challenges implied by the 'however' keyword. In still-earlier pilots, the roles were assigned more elaborate responsibilities, and participants would receive a brief training for the role prior to taking it on. For example, the Designer role (now dropped entirely) was briefed on a specific collection of design patterns.

As presented in this workshop, the roles were strictly functional and were not the focus of role play as such. Rather, an attendee would fill a given role momentarily within a conversation, while remaining fully themselves.

5.1 Input patterns

Alongside the descriptions of the roles that were given to participants (again with pattern cards), the reader may refer to Table 1 which explains the mnemonic meaning of the chess pieces which accompanied each role description. A similar informal description of the roles was also given to participants.

TIME TRAVELER ♕ (s)

Question *What has happened in the past, what could happen in the future?*
Role To provide historical context and anticipate alternate futures.

WRINKLER ♘ (m)

Question *What could go wrong?*
Role. Consider what might derail or counter the proposed solution. Each wrinkle can be assigned a level of perturbation (from low to high).

ANALYST ♙ ♗ (c)

Question *What are the moving parts?*
Role 1 Consider the current challenge and all the components of the potential solution (actors, resources, institutions). Identify and orchestrate the dynamic network of these components.
Role 2 Consider the other challenges specified beyond the current focus. Identify and orchestrate the integration of these components relevant to the present challenge.

(We also characterized some roles which would be filled by offsite and onsite facilitators.)

FACILITATOR ROLES (c)

Context Developing a collection of interrelated design patterns.
If you are getting ideas from participants who play Functional Roles BUT the ideas aren't all connected with each other in a structured way.

Role	Manipulative(s)	Explanation
Time Traveler	♕	In chess, the Queen can move linearly in any direction: forward, backward, and diagonally. Similarly, the Time Traveler role 'moves' both backwards and forwards in time, and also explores the conditions that appear at those points in time.
Analyst	♗, ♗	In chess, there are two Bishops, both of which move diagonally, so that both are restricted to different colored squares. Here the Analyst role divides its attention across two different spheres: articulations within the current challenge, and articulations of this challenge relative to other challenges.
Wrinkler	♘	In chess, the Knight moves in a skewed fashion: in order to go in one direction, it must also go a little bit in another direction. The Wrinkler role, similarly, looks at how a given strategy might go askew, due to unintended consequences or otherwise.
Linker	♖	In chess, the Rook moves any distance, as long as it goes in a straicoght line. The Linker role, similarly, can record a link between any two related concepts. Since all concepts are potentially related in some fashion, the Linker focuses on making *useful* connections.
Reflector	♔	In chess, capturing the King means the end of the game, so players are concerned throughout with any threat to their King. Here, the Reflector role senses how the discussion of a given scenario is progressing and when it would be good to draw it to a close and move on.

Table 1. Mnemonic for manipulatives based on the chess set

Then introduce facilitator roles to help structure the collection.
Specifically, Linkers, and Reflectors are two roles that we have found useful.
The following patterns describe specific functions which were filled by offsite and onsite facilitators.

LINKER ♖ (c)

Question *How do proposed scenarios build into patterns across layers, and how do they interact within the constellation of related concepts?*
Role. Data wrangling as it comes in, providing visualization of patterns and interconnections.

REFLECTOR ♔ (s)

Question *How is the scenario evolving?*
Role To appraise each developing scenario, provide a format for reflection (e.g., PAR), make a decision to continue, reset, or end.

In the spirit of Increasing Participant Control, *the* Facilitator roles *could be distributed to participants, though doing so in a future workshop would require spending more time on training, and potentially also improved tooling.*

5.2 Itinerary

Public spaces are the foundation of healthy communities.

0930-1000. Arrival, tea and coffee (Waterside 3)

Informal meet-and-greet with other attendees.

1000-1030. Media screening and introduction to the workshop (Cinema 2)

Abby will outline the aims of the workshop. Judith will introduce polyphonic documentary as a way of communicating beyond the workshop. Consent forms needed for the next phase.

1030-1045. Introduction to the hands-on activities (Waterside 3)

Joe will walk through this itinerary, as an overview of the workshop itself.

1045-1230. Session 1: experts to citizens (Waterside 3)

In this session we aim to get everyone on the same page, using big sheets of paper and whiteboards.

***Dérive Comix*:** Share your mental images of "public space & public health" (feel free to refer to photos on your phone or other data you've brought along).

***Meaning Map*:** Combine and structure each group's data in drawings and diagrams, finding common themes.

***Envisioning the future*:** Share key findings as *future stories*, which we will collect in one overall map.

1230-1330. Lunch (provided) 🍲

1330-1500. Session 2: citizens to action (Waterside 3)

In this session we explore the scenarios that we developed and identify paths to action.

When you return from lunch, the offsite facilitators will have created a digital version of the meaning map. They will walk through what they've created. Joe will describe the hands-on methods that we will use to communicate our findings from this session to the offsite facilitators, who will use them to elaborate the map.

We will ask you to map out the challenges that your future stories present, and ways of addressing them, using the four keywords and blank cards as your "game board", and using the roles to elaborate the findings.

1500-1515. Review (Waterside 3)

5 minutes summary from Abby and Joe; 5 minutes outlook on Phase III from Leo and Noorah; 5 minutes comments from participants.

1515-1530. Close (Cinema 2)

***(10 minutes) Media screening*:** We will watch some short films depicting public space, with new eyes.

(5 minutes) Closing remarks from Abby

1530-1700. Reception (Watershed bar) 🥂

5.3 Intermediate artifacts

Intermediate artifacts generated within the workshop included mindmaps created with participants, on paper. We used a graphical template following the outline of the Causal Layered Analysis layers to explain the workshop's overall workflow, and also asked participants to use a version of this diagram as a "grid" for note-taking within Phase I, to encourage them to work from their observations to the core underlying themes and issues. Participants

Fig. 4. Use of diagrams and manipulatives to create meaning maps and new patterns (paralleling *MA 1.3 Mining Atmosphere* from Iba and Isaku [2016]. In the upper-left photo, the CLA layers are mapped to concentric circles; from outside to center: litany, system, worldview, myth. The Share Back pattern was used to collect core themes from groups working separately, conceptualised here as the basis of a shared myth (lower left). Pattern Language Components were then used to sketch solution strategies to key problems and concerns, e.g., Funding of Public Space (right).

then clarified these core themes in a share-back process, and in Phase II, developed them further in the form of shared future stories, outlining paths to action. Photos in Figure 4 show the movement from:

- Initial sketching at the start of Phase I, beginning at the *litany* level, within small groups, to:
- A collection of themes shared across groups at the end of Phase I, to create a Meaning Map which, in CLA terms, is intended to bring everyone into a shared *myth* layer, on to:
- Phase II work using Pattern Language Components, to identify both general and specific possibilities for action around a theme.

5.4 Output patterns

Participants created several patterns by making use of the Pattern Language Components *and* Functional Roles. *Here, the material shared by participants is summarized and condensed in proto-pattern form. For an example showing how the patterns looked in the workshop, see the right-most image in Figure 4, which details the participants' articulation of the* Funding of Public Space *pattern (with help from a workshop facilitator).*

⛏️💎 CONTESTED SPACE (s)

So-called public space doesn't always feel welcoming to all members of the public. It can be overrun with antisocial behavior. It can feel exclusionary, or uninviting. It can be the site of conflict. Although the uses of public space are complex, each space need not support every use equally.

⛏️💎 REBALANCE SOCIAL SERVICES (m)

Welfare-related services should be supplied in balance with local needs, though they often are not. Can varied expertise be integrated in a similar way to the domain-specific skills practiced by Médicins Sans Frontièrs to address complex local challenges?

⛏️💎 FUNDING OF PUBLIC SPACE (c)

Even though public space is known to increase wellness in the population, well-being priorities that would lead to increased funding for public space aren't universally adopted. In order to make the benefits of such investment clear, increase transparency around investments in public welfare, e.g., create a register of impacts of local social enterprises.

Reflecting on the contributions of Abby Tabor as workshop convenor, and special guest Judith Aston who framed our activities in relation to broader 'interactive documentary' practices [Aston et al. 2017], we can observe a simple pattern that would be useful in subsequent workshops.

CONTEXT SETTING (s)

Context A workshop or other working context has been convened.
If the facilitators have ideas that they would like to explore with attendees BUT these ideas are not top of mind for attendees.
Then do some context-setting, e.g., showing videos, giving a short talk about why people have been invited and describe the hoped-for outcomes.

With hindsight, another role comes to mind, which was not explicitly presented in the workshop, but which echoes our overall aim to identify possible paths to action. The Stepper *role harkens back to the use of "next steps" together with patterns, introduced in Corneli et al. [2015]. Table 2 supplements Table 1 with a description of the corresponding mnemonic.*

Role	Manipulative	Explanation
Stepper	♙	In chess, Pawns move one space at a time (or two at the beginning of their movement). Pawn are individually weak, but collectively, their placement is important for strategy. The Stepper role similarly describes the immediate next actions that should be taken at a point in time.

Table 2. Mnemonic for the Stepper role

STEPPER ♙ (m)

Question *What should we do next?*
Role Consider the discussion so far, and the various possibilities for action that have arisen. Decide which actions would be most useful or informative, and devise a plan in place to carry them out.

A related ambition, which we did not realize within the scope of this project, was the creation of a wiki, which would have been a place to collect next steps, and share updates and reportage on collaborative work around the possible actions surfaced during the workshop. Instead, the notes taken by off-site facilitators were presented back to participants in a (non-editable) wiki-like prototype. Cf. Case Study 3 for further details of a related prototype.

5.5 Further remark on the Roles of Roles

Relevant high-level next steps following up on this workshop would be revise and re-articulate the proto-patterns above in more formal terms, alongside a process of evidence-gathering that would support or refute the value of specific interventions which ramify the patterns in their local context. These future operations might be supported by new Functional Roles, or by further elaborations of those already described above. Indeed, review (e.g., during a PAR) of the contributions to the process that were made by different roles could help to articulate the need and plan for evolution at the process level. Presently, with Table 3 we draw attention to the way in which the participant roles outlined above operationalize key aspects of the Active Inference Framework (see Smith et al. [2022] for a primer on the key concepts in AIF).

Time Traveler	contributes to elaborating *the prior belief over states* and the *likelihood of specific observations*.
Analyst	contributes to elaborating the *generative model*, with the division between inward and outward articulations corresponding to *internal* and *external*-facing (i.e., *sensory* and *active*) states.
Wrinkler	contributes to elaborating the *factor of surprisal*.
Stepper	takes action to correct discrepancies between the generative model and the perceived state of the world, minimizing *prediction error*.

Table 3. Key factors in the Active Inference Framework are reflected in participant roles

Active Inference is currently being explored as a new paradigm for artificial intelligence [Albarracin et al. 2023; Friston et al. 2022]. Here, we suggest that AIF and DPL can support each other, with AIF concepts being given a practical implementation using design pattern methods, and DPL receiving a needed theoretical upgrade from Active Inference. The Functional Roles in Table 3 focus on the generation of next steps. Another notable commonality between DPL and AIF is that both typically make use of hierarchically organization, e.g., *A Pattern Language* zooms in from patterns for towns to buildings to construction; whereas AIF zooms out, from "I model the world" to "we model the world" to "we model ourselves modelling the world" [Kirchhoff et al. 2018].

This suggests further strategies for building structured approaches to complexity. For example, Benoit and Jabari [2019] paraphrase Christopher Alexander's conception of urban development: "'natural' cities evolve by maintaining their amount of surprisal constant on average." Further elaboration and orchestration of Functional Roles could provide similar guidelines for the evolution of pattern languages, helping to ameliorate the structural limitations of pattern language development, such as those described by Dawes and Ostwald [2018].

6 CASE STUDY 3: OPEN RESEARCH FUTURES

This workshop was developed as an "Away Day" for faculty and staff members at Oxford Brookes University. The aim of the workshop is to elaborate the institution's open research strategy relative to its existing organizational strategy. Methodologically, this workshop builds on a pre-seeded Org Roam network of interlinked themes and an additional activity that enlists attendees in taking concrete actions on the identified next steps. This itinerary reused the language "experts to citizens", "citizens to action" from the previous workshop (with a slight variation suited to the context). It is worth remarking here that these phases mirror the Dérive Comix—Meaning Map—Reinfuse Expertise structure introduced in the first case study, and that, in CLA terms, the effect is a journey from *litany-to-myth-back-to-litany*, with the new litany taking the form of potential actions.

6.1 Input Patterns

DO YOUR RESEARCH (s)

Context Prior to beginning a formal workshop or other participatory research activity.
If it looks like it will be possible to do participatory research BUT the participants haven't begun speaking with each other yet.
Then start doing the research in a more centralised way before inviting direct collaboration, in order to give participants something to engage with.
Example In the current setting, this pre-research included 1-to-1 interviews with about half of the invitees, as well as internet research to find and explore related scenarios developed by others.[6]

STRUCTURE CONVERSATIONS (c)

Context Having convened a workshop or other participatory research activity.
If unstructured discussions are likely to take lots of time but without yielding concrete benefits.
Then structure the discussions around shared interests to move things forward more effectively.
Example At this workshop, we decided to group participants around tables according to the faculty where they were employed (or most closely aligned, in the case of university-level support staff).

THE FUTURE BEGINS NOW (m)

Context Having developed possible next steps in a discussion.
If it appears that leaving the discussion without concrete commitments means concrete actions are less likely to take place.
Then take preliminary actions before leaving the discussion to create a sense of commitment and follow-through.
Example One way to build commitment would be to ask people to develop and share a method for a small-scale experiment that they plan to carry out.

In the event, there was not enough time to do the activities described in The Future Begins Now *within this iteration of the workshop. One possible reason for this is that the* Stepper *role, introduced in the commentary in Case Study 2, had not been conceptualised, and handed out to participants in this workshop. So, even though participants were invited to think about potential next steps using the* SPECIFICALLY *keyword from the* Pattern Language Components *pattern, there wasn't a corresponding* Functional Role *which would help participants "own" those steps.*

[6] https://royalsociety.org/topics-policy/projects/research-culture/changing-expectations/visions-of-2035/visions-of-2035-materials/

6.2 Itinerary

Open Research can accelerate progress on Brookes 2035 Strategy

1000-1015. Arrival, tea and coffee ☕

Informal meet-and-greet with other attendees.

1015-1030. Introduction to the themes of the workshop

David Foxcroft will introduce the context and aims of the workshop: the Open Research Programme, and the way what we're doing relates to Brookes strategy and vision. The "SOLACE" acronym is useful for organising this.

1030-1045. Introduction to the hands-on activities

Joe will walk through this itinerary and give an overview of the workshop, briefly describing where the methods came from (Corneli & al., 2021), and what can be expected based on previous pilot workshops.

1045-1230. Session 1: Experts to citizen/scientists

We have an initial "map" of open research at Brookes, based on interviews with the Open Research *ad hoc* Advisory Group. Today, we will work in ≈4 small groups, organised by faculty, to elaborate this map. We will draw on our experience as consumers and producers of research, organising our observations by their depth of meaning. We will share our findings with the larger group as "future stories".

1230-1330. Lunch (provided) 🍲

1330-1445. Session 2: Citizens to action

In this session, we explore the future worlds we imagined and identify potential paths to action. We will do this using two simple design languages. The first helps us find patterns in our current context. The second helps us see how those patterns evolve over time. Both phases will be lightly facilitated, with share-back at intermediate points.

1445-1455. Comfort break 🚽🌲💨

1455-1545. Session 3. What now?

In the previous session, we identified possible next steps and their potential ramifications. We will use this session to discuss the *first steps* that we want to take following this meeting, and the accountability that we want to put in place following the workshop. We will use some of the publication types available on Octopus.ac to write these up.

1545-1600. Closing

Reflections on the day.

6.3 Intermediate artifacts

Figure 5 shows how the Pattern Language Components were used in the second phase of the workshop, building on a CLA-based discussion that developed the Meaning Map in the workshop's first phase (background, right). In this case, the keywords and manipulatives corresponding to Functional Roles (cf. Table 1) were not used to spell out entire draft patterns (as in Figure 4), but rather, to generate a network of relations.

Fig. 5. The Pattern Language Components were used organically within the workshop.

Figure 6 shows how material was then drawn together, using Org Roam to analyze the workshop themes (per the Linker pattern), further elaborating the Meaning Map. Contents of the paper-based diagrams, like those in Figure 5, were condensed and edited in the digital notes, rather than represented verbatim. For example, the idea of reintroducing a "common room" (Figure 5, left) is folded into the "Research Environment" node, along with the challenge of holding conversations when "people aren't here" in person. The digital notes also provided an opportunity for corrections, consolidation, and synthesis of links which hadn't been spelled out directly with the manipulatives. E.g., "Richard Owens" [sic] (Figure 5, right) is represented in the digital notes as *Richard Owen*, key proponent of responsible innovation [Owen et al. 2013], within the "responsible" node.

The overall process illustrated in Figure 6 moves in the opposite direction of *Figures 3-7* of Iba and Isaku [2016], insofar as those figures complexify a tree as a graph. Here, we move from an interlinked graph of topics to a summary map in tree form, represented here by the Outline of an Open Research Action Plan node. This process relates to the interplay of informal and formal work, elaborated in Appendix A.

In brief, the organic, playful, interactions within the workshop were useful in creating the more formal output (a draft policy document) precisely because these interactions were informed by a suitable metalanguage, including the apparatus of Causal Layered Analysis, the Pattern Language Components, the Functional Roles, the Meaning Map, and other patterns described so far in the paper. By contrast, the acronym "SOLACE" mentioned in the itinerary—which aims to describe an approach to research that is grounded in organizational values "Success, Openness, Learning by doing, Adaptability and Creativity, and Equal opportunity" [Corneli 2023]—was primarily useful for Context Setting. That level of analysis only provides a "mental picture", in the terms of Alexander [1964]. A hypothetical Open Research Action Plan based on stakeholder interviews and the "SOLACE"

concept, omitting the workshop experience, might express the university's values, but it would not draw on the same richness of meaning, nor the same level of practical detail.

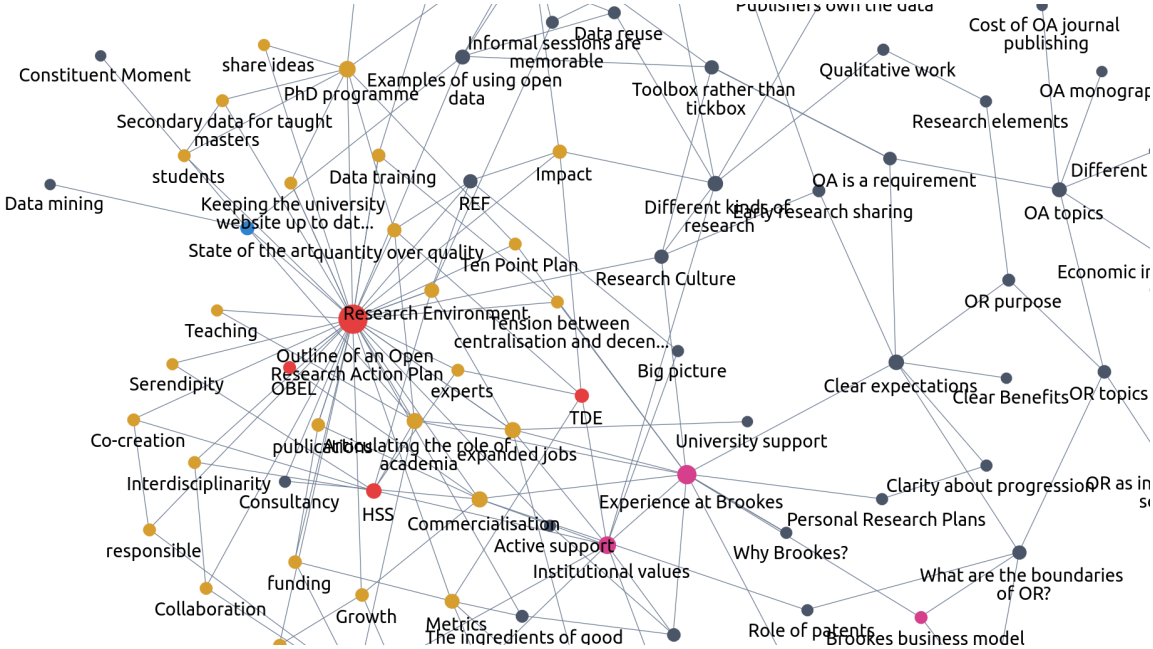

Fig. 6. Screenshot of Org Roam UI, showing the development process leading to a draft Open Research Action Plan (ORAP). Color-coding is: (Gray) Background themes and concepts based on interviews (cf. Do Your Research); (Purple) Selected themes from that background material which became the focal themes in the workshop; (Yellow) Workshop themes and concepts; (Red) Key points of organization for workshop themes, including discussions per faculty as suggested by Structure Conversations. The node "Outline of an Open Research Action Plan" includes the ORAP, instantiated here as a bullet-point outline, with links to all of the workshop outputs.

6.4 Output Patterns

The process of condensing wide ranging interviews and workshop discussions into a draft report suggests the following broadly useful pattern:

💎 STRUCTURE OUTPUTS (m)

Having gathered themes from a participatory project, they may have some explicit (e.g., because of how the information was gathered, cf. Structure Conversations). Additional structure can be created, if you link intermediate artefacts into a relevant template.

Our way of working with Pattern Language Components *within this workshop suggests another pattern going in the opposite direction of formality:*

💎 DESTRUCTURE PATTERNS (c)

The Pattern Language Components need not be used to articulate entire patterns: a less formal discussion can surface useful meanings.

7 CASE STUDY 4: CIS 9590, INFORMATION SYSTEMS DEVELOPMENT PROJECT

7.1 Introduction to the course from the instructor, Mary Tedeschi

CIS 9590 is Information Technology Project Design and Management is the "Computer Information Systems" (CIS) capstone project course for the CIS major wherein the students will apply concepts and techniques from prior course work, to design, develop, and create an implementable application for a working information system of an actual business. It also focuses on the design and management of systems to meet the increased need for information within an enterprise. The course exposes students to the fundamentals of IT project management required for the successful implementation of IT-based systems. The course presents tools and technologies for project definition, work breakdown, estimating, planning and scheduling resources as well as monitoring and control of project execution. Students utilize knowledge gained from prior coursework, and work in groups to design and manage an Information Technology project. During my first semester, Spring 2020, teaching with the students using whatever development tools they were familiar with, I noticed this to be a problem so with this knowledge I changed the course to require the use of Intel One API. This did not get implemented until Fall 2021. I actually taught the course three times before requiring students to use the same software tool uniformly. The course was a 3 hour course, first face-to-face. Then synchronous online only. In Fall 2021 we changed to 75 minutes in person and online (hybrid). Students had to self-teach Intel One API with the use of tutorials and a buddy system. The students seemed to have the necessary skills to learn enough of the software to create an implementable application. This semester, Spring 2023, the students really seemed to lack the coding skills.

7.2 Our use of "Patterns of Patterns" within the course, by guest lecturers Raymond Puzio, Joe Corneli, and Charlie Danoff

We used the paper "Patterns of Patterns" as a focal text with three successive cohorts of CIS 9590 students. The course syllabus is focused on developing group projects with a computer programming component. Our hope was that the topics in the paper would inspire them with new ideas about design and collaboration. We focus primarily on the latest iteration of the course (Spring 2023), in which we made the most explicit use of the methods described above. Figure 8 shows some of our anticipations of the relevant concerns that apply in this context. Each semester, students asked many thoughtful *questions* about the paper; they also produced their own *written response* to the paper, engaging the original paper in depth; and in the latest run, we offered some in-class *exercises* based on the workshop methods described above. Reading these written responses showed that the students had not only understood the main ideas of our paper, but added to them. In effect, they created alternative imaginaries for the paper's history and future. For instance, in their 2022 'case study', they generated a "Recommendation and Implementation Plan" which proposed specific actions which a group could take based on our ideas; and, in 2023, the students produced a slide presentation based upon our paper, exploring its relationship to themes such as "emerging technology". It is worth highlighting that while our paper did touch briefly on the theme of emerging technology, the students considerably elevated the importance of that theme in their feedback.

7.3 Experience report by CIS 9590 student, Kajol Khetan

The PLACARD method emphasizes understanding the context, selecting an appropriate language or languages for thinking about problems in that context, and taking relevant actions to guide the development process. In our project work, we adapted the CLA component of this framework by identifying the layers relevant to our chosen problem, namely, to create a website that allows users to discover nearby coffee shops easily. We identified the following layers for our analysis (each with several facets, see Figure 7): User Interface, Functionality, Data Flow, Infrastructure, and External Factors.

CLA guides us to look for *causal relationships* operating within and between these layers. In particular:

User Interface Layer
Analyzed user interactions: Implemented an interactive map interface using JavaScript and integrated the Google Maps API.
Designed elements: Developed a responsive and visually appealing layout with markers representing coffee shops on the map.
User experience: Prioritized ease of use, ensuring smooth navigation, intuitive filtering options, and clear visual cues.
Functionality Layer
Core features: Enabled users to search for coffee shops based on location and preferences.
Functions/modules: Implemented search functionality, marker clustering, and information display for each coffee shop.
User feedback: Incorporated user feedback to enhance features, such as real-time reviews and ratings integration.
Data Flow Layer: Processed user inputs: Captured user location and preferences to provide relevant search results.
Stored data: Utilized a database to store coffee shop information, such as names, addresses, ratings, and reviews.
Data display: Dynamically populated the map and details sections with data retrieved from the database.
Infrastructure Layer:
Technology stack: Utilized HTML, CSS, JavaScript, and Google Maps API for the front end; PHP and MySQL for the back end.
Compatibility: Ensured cross-browser compatibility and responsive design to cater to various devices.
Server setup: Hosted the website on a reliable server with efficient performance.
External Factors Layer:
User requirements: Considered user preferences, such as coffee shop categories (e.g., vegan-friendly, Wi-Fi availability).
Business goals: Aligned with the goal of promoting local coffee shops and providing a convenient user experience.
Market trends: Incorporated emerging trends, such as real-time user reviews and social media sharing.

Fig. 7. Layers in the analysis of a coffee discovery website

- Changes in the User Interface layer influenced user engagement and ease of interaction.
- Adjustments in Functionality impacted the overall user experience and satisfaction.
- Data Flow optimizations directly affected the accuracy and relevance of coffee shop information.
- Infrastructure decisions impacted website performance and responsiveness.
- External factors influenced design choices and user satisfaction.

Our adaptation of Causal Layered Analysis led to a comprehensive understanding of the website's components and their interdependencies, and facilitated a structured approach to development. The nearby coffee shops website was successfully developed and deployed. Users can input their location and receive a map display of nearby coffee shops, along with relevant information such as ratings, reviews, and operating hours. Our group's process could be condensed into an overall protopattern:

💎 ADAPT LAYERS AS NEEDED (c)

The project's context was to provide users with a simple, intuitive platform for locating nearby coffee shops. Challenges inherent to this problem included real-time data updates and dynamic user interactions. We needed to select appropriate design and implementation *languages*, and plan and carry out suitable *actions*. The project employed Python, SQL, and Google Maps API. Layer-based analysis facilitates effective communication among team members, enabling seamless collaboration, and aides both design and implementation. Design patterns such as *MVC (Model-View-Controller) architecture*, the *Observer* pattern for real-time updates, and the *Singleton* pattern for managing map instances were integrated into the development process.

7.4 Further proto-patterns describing the course experience, by CIS 9590 student, Manny Singh

The following proto-patterns summarize one student's reflection on how our "active engagement and promises to come again in the following weeks to see progress on everyone's individual project kept the butterflies, nervousness, and willingness to deliver all alive at the same time." Further inline commentary expands and analyzes the proto-patterns using Pattern Language Components.

💎 ENGAGEMENT AND GUIDANCE (m)

The authors of 'Pattern of Patterns' actively participated in our class, to share expertise and create a collaborative learning environment. Their presence allowed us to gain deeper insights into the paper's concepts and methodologies, leading to innovative project approaches. By closely studying the patterns of patterns identified in their research, I gained a fresh perspective on project organization and established a logical and coherent structure.

Notice that within this capsule summary there are at least two implied conflicts:

- *Team work is required HOWEVER the ways to scaffold effective collaboration are not entirely obvious;*
- *Project development is required HOWEVER project structure is not obvious.*

Our interactions with both the teacher and the students helped us theorize the confusion:

- *These difficulties exist BECAUSE participants do not have enough experience grappling with 'worked examples' (both learning best practices from successful examples, and learning by giving constructive feedback on less-successful examples).*

"Patterns of Patterns" provides some generic methods that can be applied to the domain-level problems. Moreover, contact with the authors shifted the game, relative to simply reading the preprint.

- *THEREFORE, share some easy-to-understand general-purpose methods with novices, and put them in regular contact with people who have significant experience with problems in the domains of project management and collaboration.*

Thinking beyond the Spring 2023 CIS 9590 cohort to next steps, we need better ways to share this kind of experience:

- *SPECIFICALLY, can the Peeragogy project develop an internship/mentoring programme, and how would the design of such a programme be reflected in our design pattern catalogue? (After the course, one of Mary's students, Kajol Khetan, joined us as the first peeragogy intern.) Respectively, can more touchpoints for mentoring and peer feedback be built into the CIS 9590 curriculum?*

💎 AVOIDING MISTAKES (c)

The authors' insights helped me navigate common project development pitfalls. Through their emphasis on effective documentation, regular testing, and thorough project planning, I was able to avoid costly errors. Their guidance ensured a consistent progress trajectory and maintained the professionalism of my final project.

The nice features of "effective documentation, regular testing, and thorough project planning" might be interpreted in terms of PLACARD components:

- *A project needs to be carried out HOWEVER it's not clear what to do to make the project a success*
- *BECAUSE projects have fairly well-known failure modes*
- *THEREFORE teach and carry out ways to avert those failures: e.g., use Project Action Reviews to keep track of incremental steps in the development of the project; use Design Pattern Languages to design, build and evaluate prototypes; and use Causal Layered Analysis to integrate data from these to build an adaptable project plan that addresses a real problem.*

(That said, it would be helpful to offer more specific guidance, relevant to the novices' working context.)

- *SPECIFICALLY, use a resource like Hoover and Oshineye [2009] to flesh out this advice for future CIS 9590 cohorts, and ask them to document the patterns they use.*

💎 SCALING AND ADAPTABILITY (c)

'Pattern of Patterns' underscored the importance of scalability and adaptability in project design. By considering future technologies and incorporating modular elements, I aim to seamlessly adopt new advancements. In particular, I focused on building a flexible framework that could easily accommodate emerging technologies.

In the language we've been using internally, "scalability and adaptability" sounds a lot like 'working across contexts'.

- *We want a system that will adapt to situations we haven't encountered yet HOWEVER we need something reasonably specific and concrete in order to work in any given context*
- *BECAUSE we need to organize evolving complexity*
- *THEREFORE develop a modular approach to design and development, and incorporate future scanning into the workflow*
- *SPECIFICALLY let's look for more ways to develop 'alternative imaginaries' for the Patterns of Patterns project.*

7.5 Causal Layered Analysis of the CIS 9590 experience

We conclude this section with a summary reflection on our use of "Patterns of Patterns" within CIS 9590, using the (standard) Causal Layered Analysis layers. This is scaffolded by the two diagrams in Figure 8.

7.5.1 Litany. Initially our paper was introduced as a contemporary reading, relevant to the Computer Information Systems ("CIS") theme. Mary chose a contemporary paper in part because students would not be able to "cheat" in their reports, because our paper wasn't described extensively on Sparknotes or similar. Along with this (intentional) challenge, CIS 9590 students encountered a range of more or less predictable problems, e.g., many felt a lack of confidence with coding. The students came to the course with a variety of different backgrounds (e.g., Python vs C++) which contributed to some friction with this course. As guest lecturers, our initial anticipations (summarized in Figure 8) didn't precisely match our reflections at the end of the course. This suggests the potential need for more design patterns. With the benefit of hindsight, next time we might elaborate on Manny Singh's proto-patterns to give them more specificity, and influence our participation in future cohorts. More broadly, we observe that when *working across contexts*, many of the 'forces' at work within a given context are initially hidden to us. For example, we didn't anticipate the students' hesitance around coding, nor did we anticipate their taking up the cause for emerging technologies around PLACARD methods.

7.5.2 System. Whereas in our rounds of earlier participation we were more there for enrichment, in the most recent semester, our contributions were more closely integrated into the main activities of the course. We attended more sessions, including one in which we attempted to run a short version of the workshop with attendees via Zoom. Ongoing interaction saw us in an 'in residence' role, advising on various aspects of the projects. Furthermore, Mary attended at least as many meetings of the Peeragogy project (one of the centers of

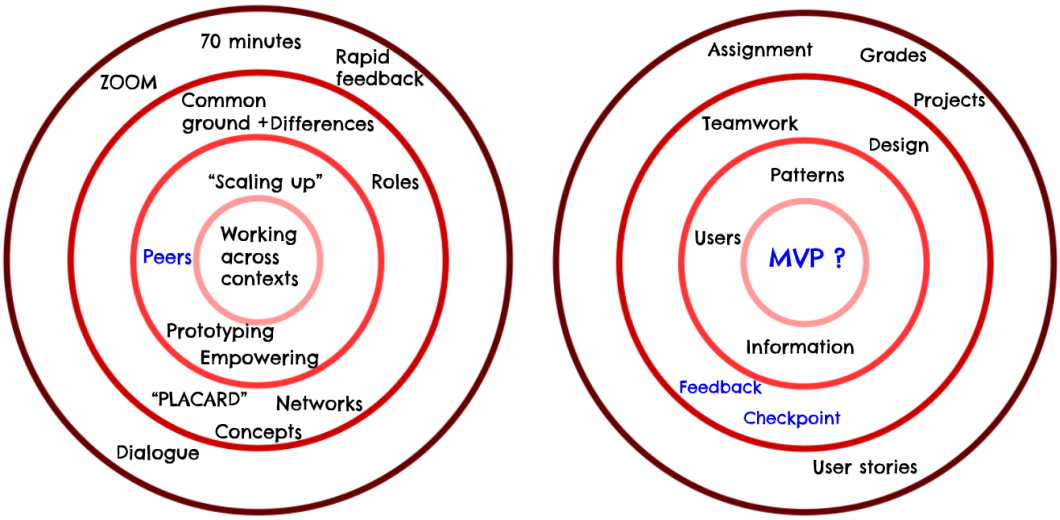

Fig. 8. Diagrams created before our first session with the CIS 9590 students, inspired by Causal Layered Analysis. The diagrams describe our working context as guests in CIS 9590 (left), and our initial understanding of the students' working context (right).

development for PLACARD) as we attended sessions of the course, fostering an exchange of ideas and viewpoints between these two contexts. In the short term, this led to productive synergy and, in the long term, could lead to our pedagogical and peeragogical initiatives becoming more integrated into a larger system. This collaboration continued post-semester, insofar as Mary invited the students to express interest in possible internships in the Peeragogy project.

7.5.3 Worldview. Students were thinking about their future careers. What they wanted to get out of the course (e.g., becoming a well-paid data scientist or business leader) at times had some friction with the practical reality of the course requirements, in which they had to deliver a concrete hands-on working project, without being able to rely on employees. PLACARD wouldn't be of much direct help with the technical challenges they faced with the Intel One platform, but we hoped it would help them organize their work in a sensible way. The ideas underlying PLACARD informed our contributions to the course at various levels; for example, in a session with Mary in which we 'workshopped' CIS 9590 with other peeragogues, discussants suggested adding more touchpoints for peer learning and feedback (*à la* the PAR). The two diagrams in Figure 8 illustrates how different meanings and priorities (including but not only at the Worldview level) can lead to tensions or even outright conflict: this suggests a paticularly salient role for DPLs in bridging between domains.

7.5.4 Myth. A deep metaphor within the classroom setting is *pedagogy*. However, the methods that we brought to the course as guests were more linked with our experience of *peeragogy*. In the new shared context, these two perspectives begin to integrate. Mary as a host exercised the value of *xenia* by bringing us into her course as guests. The possibility of student internships within the Peeragogy project would create the reciprocal opportunity for further student practice with CIS skills in an applied context, helping to build tools and platforms for peer learning and peer production (including through use of pattern methods). Indeed, the particular combination of peer learning and formal education developed here led us to wonder how far off the Peeragogy project might be from being able to support informal learning of relevant programming concepts (preliminaries to CIS 9590) or applied

computing projects (an analogue of CIS 9590). The students' emphasis on the theme of 'emerging technology' suggested that whatever synthesis develops, it may include significantly upgraded technical components. We've seen a corresponding need for emerging methods, e.g., in Kajol Khetan's suggestion to Adapt Layers As Needed.

8 DISCUSSION

We presented the patterns that we developed and used over successive runs of our workshop, in approximately chronological order, duly revised for publication and subsequent re-use. Our accompanying narrative showed how the application of certain patterns gives rise to the "seeds" of new patterns. It may now make sense to think of our Open Future Design workshop methods as a nascent pattern language which operationalizes the PLACARD pattern. Our first workshop mixed Pattern Language Components with Functional Roles, putting participants in the thick of a pattern-related dialogue. While this led to interesting conversations, it was more work to extract any patterns. However, we did find some useful process patterns this way, such as Increase Participant Control. We employed what we learned in subsequent runs. In the second workshop, a more distinct use of the Pattern Language Components helped the participants come up with their own patterns.

There is an interesting interplay between the domain-level patterns that were devised by workshop participants and the process-level patterns that describe the workshop itself. For instance, the workshop setting is akin to a public space, and issues like Contested Space would apply there, whenever different participants have different conceptions of how they want things to go. Further development of the tools associated with the workshop might make it even more of a public resource—somewhat like Wikipedia, but endorsing the contribution of original research, rather than forbidding it. This remark should simultaneously recall the analogy between wikis and pattern languages [Cunningham and Mehaffy 2013], and frame the need for it to develop.

In order for any pattern-informed research to work well, we should be gathering evidence for or against the salience of the patterns that are elaborated. The Octopus[7] platform mentioned in the itinerary for Case Study 3 uses several data types that follow the rough outline of a scientific paper; amongst them, the "Problem", "Rationale", "Method", and "Results" components are particularly familiar for pattern authors. Much as Octopus disaggregates research papers, our experience in Case Study 3 suggests that when engaging with complex problems, it can be useful to Destructure Patterns as well.

An archive of patterns and pattern components could be upgraded with tools that go far beyond archival purposes. Because of the particular practical aims of the exercise, Figure 6 in Case Study 3 centers on the "Outline of an Open Research Action Plan" node, towards which the several layers of data-gathering and analysis are all directed. However, in principle, any one of the nodes could itself become a center for further inquiry, e.g., in the first instance, simply by restricting the graph to a neighborhood around that node. A shift in the analytic focus may also correspond to a shift in the layers of analysis, for example what looks like "litany-level" from one perspective may be viewed as a "system-level" node from another.

The foregoing remarks suggest a relationship between *patterns* and *research* that should be pursued further. As discussed in Case Study 4 (and at length elsewhere in the literature) there is also a fruitful relationship between *patterns* and *education*. Our concluding case study illustates one way in which patterns can bridge between education and research. A further example is warranted. In Figure 9, we show how our experience with CIS 9590 could inform a future Introduction to Computing course for high school students. Here, part of the *system* layer envisions 'multiple circles' (i.e., multiple instantiations of the four-layer CLA template) which would express the developing perspectives in different groups of students collaborating together in the course. These would be integrated into one overall perspective through a 'monitoring' interface used by the instructor, elaborating on our aim of *working across contexts*.

[7] https://www.octopus.ac/

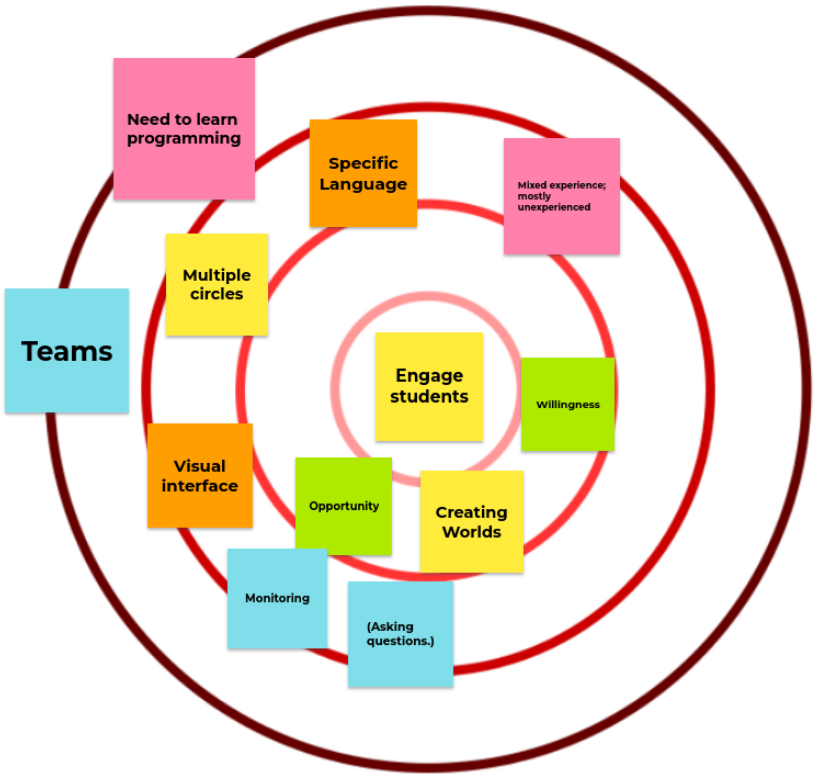

Fig. 9. We used the CLA template to plan a future Introduction to Computing course for high school students

9 SUMMARY

The primary contributions made in this paper can be summarised as follows:

- Table 4 pulls together the patterns we have described from across the separate case studies, and organizes them in groups, elaborating our previous use of "PAR", "CLA", and "DPL" methods (summarized in Section 2.1) with *a rounded outline of the purposes that sensory, cognitive, and motor methods serve when working with design patterns.*
- Figure 10 summarizes the patterns in a visual way, constituting a Meaning Map for our "patterns of patterns". This visual summary in Figure 10 is elaborated in textual form in Appendix B. In short, like a round wheel that rolls better on round ball bearings, *our analysis of the "Patterns of Patterns" can make work with patterns more efficient.*
- Figure 11 re-presents selected patterns from the paper in *a practical format for use when co-designing future workshops, or other related interactions.*[8] Whilst the collection of patterns has been refined through practice and critique, we make no claim of completeness. "Blank" cards in Figure 11 explicitly suggest that further patterns can and should be added. *Through our examination of* Functional Roles, *we now have an improved understanding of how and when new patterns are likely to be needed, as well as how to develop them.*

[8]"Open Future Design Workshop: Together with workshop participants, we will co-develop a Design Pattern Language for envisioning, exploring, and enacting the future." Wikimania 2023, https://pretalx.com/wm2023/talk/WVLJRV/ (Recording: https://www.youtube.com/watch?v=R2Sxs7lHv9w&t=13590s)

PLACARD	'By using the PAR (or another sensory method), we are able to identify recurring themes. Then, by using the CLA (or another cognitive method), we are able to organize these repeating themes in a structure that exposes the underlying trends, causes, and potential terminating states. With DPL (or another motor method) we can make what we have learned actionable.' [Corneli et al. 2021]	
Sensory:		
	Dérive Comix	'document what you see'
	Share Back	'individual groups should present key findings'
	Pilot to Anticipate	'anticipate the issues likely to arise in future iterations'
	Time Traveler	'provide historical context and anticipate alternate futures'
	Reflector	'appraise each developing scenario'
	Contested Space	'each space need not to support every use equally'
	Context Setting	'describe the hoped-for outcomes'
	Do Your Research	'start doing the research in a more centralized way'
Cognitive:		
	Meaning Map	'get everyone on the same page'
	Pattern Language Components	'build patterns piece by piece'
	Facilitator Roles	'structure the collection'
	Analyst	'identify and orchestrate the dynamic network'
	Linker	'providing visualization of patterns and interconnections'
	Funding of Public Space	'create a register of impacts'
	Going Meta	'explore how the project's methods can be applied to itself'
	Structure Conversations	'structure the discussions around shared interests'
	Adapt Layers As Needed	'layer-based analysis facilitates effective communication'
	Avoiding Mistakes	'navigate common project development pitfalls'
	Scaling and Adaptability	'aim to seamlessly adopt new advancements'
	Destructure Patterns	'a less formal discussion can surface useful meanings'
Motor:		
	Reinfuse Expertise	'enable richer and more complex thinking'
	Functional Roles	'introduce different perspectives' (in bold here)
	Wrinkler	'what might derail or counter the proposed solution'
	Stepper	'decide which actions would be most useful'
	Increase Participant Control	'participants should not remain only an audience'
	Rebalance Social Services	'address complex local challenges'
	The Future Begins Now	'take preliminary actions before leaving'
	Structure Outputs	'link intermediate artifacts into a relevant template'
	Engagement and Guidance	'create a collaborative learning environment'

Table 4. Thirty "Patterns of Patterns"

Fig. 10. Our "Patterns of Patterns" mapped to the four CLA layers. (Color code: blue=sensory, green=cognitive, red=motor.)

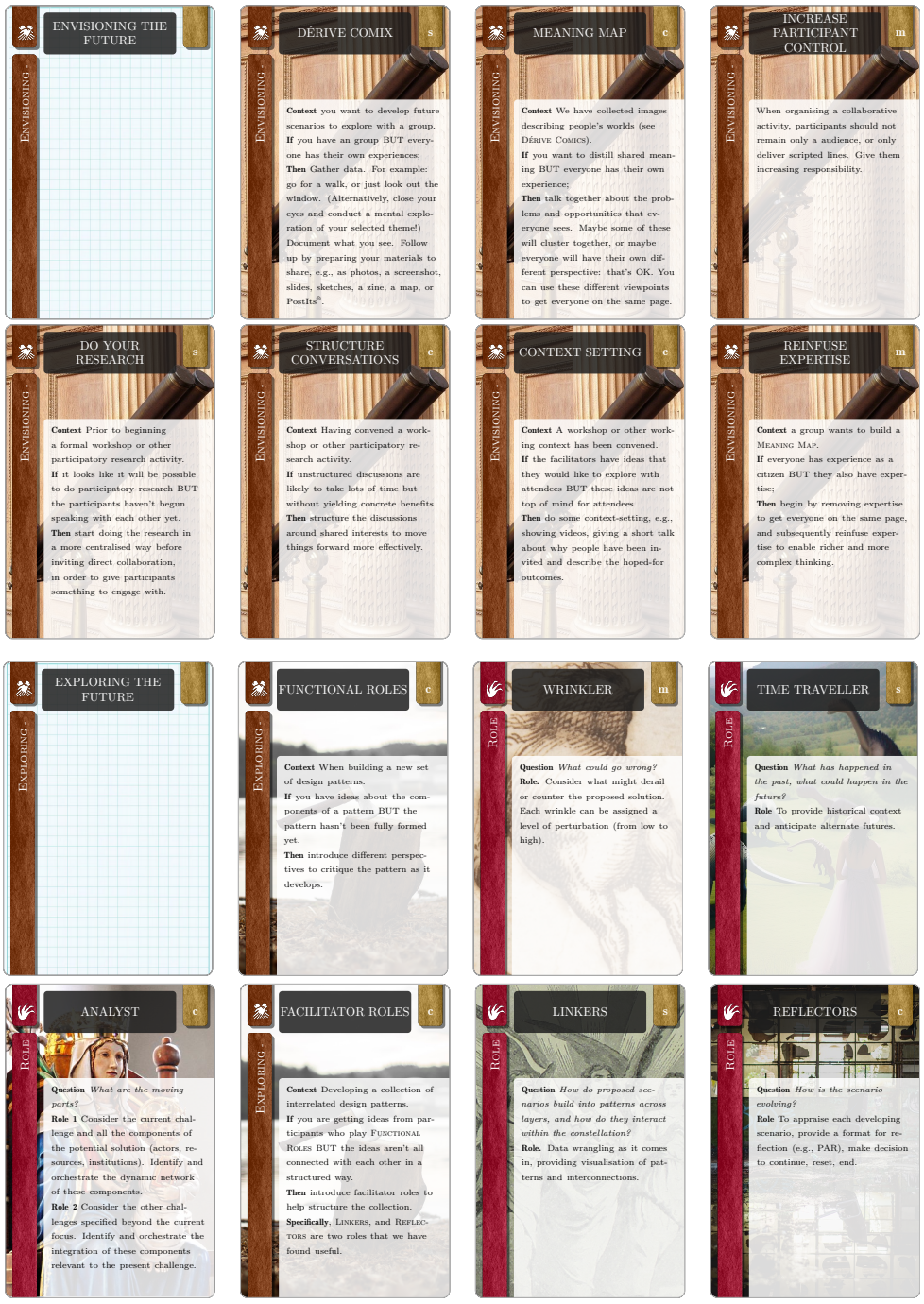

Fig. 11. Selected pattern cards, representing 14 patterns in manipulative form (with two "blanks")

10 CONCLUSION

We carried out this work with the intention of designing the next steps for our platform and process, and this seems to have been successful. As an immediate outcome, we developed the "PLACARD workshop"—now retitled the "Open Future Design Workshop"—across several successive runs, in different organizational contexts, in a way that makes it fairly robust. That success notwithstanding, the scope of "Patterns of Patterns" was larger: our expressed aim was to support collaboration across widely distributed contexts.

Although the work presented here was both wide-ranging and participatory—and, indeed, we did prototype-level distributed-working inside the workshops, via the Share Back pattern—we have not yet implemented a fully distributed peer-to-peer collaboration platform that can work effectively at a large scale. However, considering the paper as a whole, we have created something like a client-server simulation of one. For the facilitators, the workshop has repeated with variation over time, allowing us to learn, gaining insights from the workshop pilots which will contribute to the design of a platform for distributed collaboration.

Alongside our concurrent prototyping efforts, one such crucial insight is that the meta-level is just another domain. All methodological systems that aim to be practical—whether patterns of programs, public health, open research, climate adaptation, or patterns of patterns—should include predictions about the causal connections between actions and measurements, and should incorporate strategic intelligence to articulate action.

More work would be needed to fully describe our patterns' application domains, to build evidence of the kinds of results that can be expected, and to fully describe their interconnections as a pattern language.

Clearly, that be usefully complemented by supportive software development. For example, a not-so-distant future for Org Roam would allow several facilitators to make notes in near real-time into a shared map; and with further fine-tuning of the Emacs interface, a similar workflow could be used directly by workshop attendees, even across different contexts. Many rich dialogues might ensue: already we have seen the potential for fruitful cross-disciplinary interaction between people from fields as disparate as future studies, health sciences, open research, and information systems. Existing systems such as Alkemio[9] are being built with the need for collaboration across organizational boundaries in mind, preferring *challenge-focused* collaboration.

An approach centered on DPLs which work *across related challenges* would take that idea even further. A knowledge management tool like Org Roam could be augmented with additional "emerging technologies" that make it more useful for the entailed complex collaboration needs. Domain-level design patterns outline potential new behaviors; improved support for the process of gathering evidence that those behaviors do (or do not) in fact work as intended is an ambitious but logical ramification of the pattern method. A further step is needed to articulate the learning apparatus that underpins such mechanisms in a computationally-coherent way. The Functional Roles we've set forth here provide an early informal articulation of the process, and the connections to the Active Inference Framework that we alluded to in Section 5.5 could scaffold further, more formal, developments. Although it is beyond the scope of the current paper, it would be interesting build on these remarks in a way that integrates programming- and software-specific design considerations, as described, e.g., by Felleisen et al. [2018] and Löwy [2019].

Regarding our aim to support large-scale distributed collaboration, whatever underlying formalism is used, and independent of which technologies are used in the implementation, further work is needed to identify analogies between action arenas, highlight the ramifications of complex actions, show predicted costs and benefits, search for tipping points that allow the effects of change to reach across level boundaries, and surface new questions for consideration. We have begun (as we mean to carry on) by focusing on the development and articulation of multi-purpose tools for thought that can help to address these challenges.

[9] https://alkem.io/

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A RELATIONSHIP TO ALEXANDER'S "SYNTHESIS OF FORM"

In this paper and the previous paper on "Patterns of Patterns" we have considered the problems faced by groups of people organizing their activities. This can be usefully related to two diagrams from Alexander's "Notes on the Synthesis of Form", recopied below as Figure A.1. Parts a.-c. of this figure have two columns corresponding to context/form (or in the terms Alexander uses in his work on patterns: problem/solution), and one, two, or three rows, corresponding to the "actual world", "mental picture" and "formal picture". A design problem is posed at the level of the actual world, say, "build a house atop this hill" or "make a celebration song".

The design problem can be solved at one of the three levels. The most direct approach is to work in the actual world. For instance, a musician might pick up an instrument, start playing something, try out different possibilities, modify notes or phrasings to make it sound better, and so come up with a song.

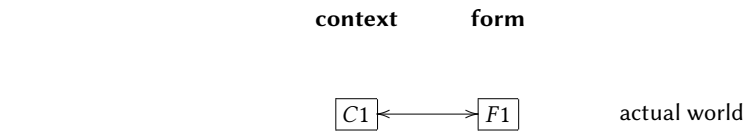
At the level of "mental picture", a designer receives design requirements which describe the problem, and produces a plan which describes a solution. For instance, the host of the party might make a request "Write a joyous song for alto voice accompanied by flute, trumpet, and saxophone to celebrate the acceptance of our paper into the conference." A composer might then sit down at a desk, away from any instruments, and write out a score which would later be handed to the singer and instrumentalists for performance. Alexander points out that there is a danger in this process: the composer would no longer have the immediate feedback which comes from working directly in the actual world. Accordingly, the result might be a song that matches the description, but doesn't match the mood of the event.

Alexander's proposed solution is to produce a formal picture of the mental picture, and instead work with that formal picture. For our example, it might take the form of a suitably elaborate music theory, one that includes concepts like '*ballabile*' (which indicates that the song should be danceable). More generally, we employ a suitable metalanguage to reason about the mental representation; this process of reasoning can then take the place of feedback from the actual world in guiding and evaluating our designs. For Alexander, this consists of a set-theoretic formalization of design requirements and potential misfits.

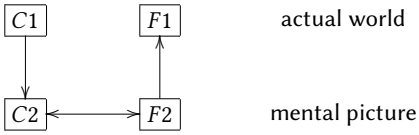
Figure A.1d refers to the process of design once we have arrived at the "formal picture" level. The left panel represents the analytic process in which one decomposes a design problem into subproblems and the right panel represents the complementary synthetic process in which one successively combines solutions to subproblems to arrive at a solution to the original problem. Alexander proposed a maximum entropy method for carrying out the analysis and, in later works, introduced design patterns for use in the synthesis; and ultimately, described 15 principles that could guide a design at an even more abstract level.

The naive "actual world" approach (Figure A.1a) would be when a group takes a "seat of the pants" approach to dealing with issues as they come up in the course of work. PAR can help to sketch a "mental picture". CLA and DPL can be used as techniques for analysis and synthesis at the "formal picture" level. Just as even a talented musician without a solid grasp of music theory would be hard pressed to compose an augmentation canon

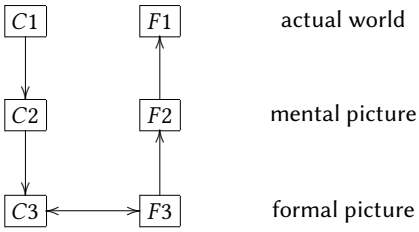
or symphony, so too we suggest that a group which faces complex challenges may want to consider these techniques for orchestrating their activities. In sum, the methods we've discussed can be used to operationalize a strategy that is at the heart of Christopher Alexander's oeuvre.



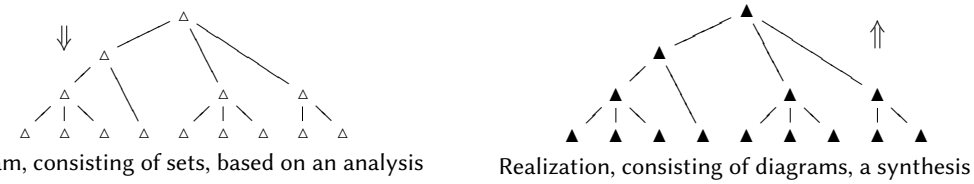
a. In this point there is a close relationship between content and form, and they evolve together.



b. In this setting we add a mental picture C2 that abstracts from the context (e.g., design requirements). This corresponds to F2 e.g., plans), and F1 abstracts further (e.g., a description of the plan). This allows specialization but there is no direct link between C1 and F1.



c. Now we add a meta-language: the formal picture corresponding to the mental picture.



d. At this level we have methods for actually doing the programming.

Fig. A.1. Diagrams from *Synthesis of Form*

B SUPPLEMENT: ANALYSIS: CLA APPLIED TO "PATTERNS OF PATTERNS"

B.1 Litany: Understanding data, headlines, empirical world (short term change)

Our Open Future Design workshop has evolved several features which are retained across implementations. Participants can expect Context Setting from convenors/facilitators, as well as an introduction to Pattern Language Components, and Functional Roles. Workshop outputs are created collaboratively, with support from people filling Facilitator Roles. We have seen that Open Future Design process can help people articulate and grapple with issues they see in their lives and communities, for example Funding of Public Space, Contested Space and the need to Rebalance Social Services. This list is representative rather than exhaustive.

B.2 System: Systemic approaches and solutions (social system)

The workshop proceeds through a combination of process steps (Dérive Comix, Meaning Map, Reinfuse Expertise), supported by facilitators who work behind the scenes to Do Your Research, and more overtly to Structure Conversations and Structure Outputs. Participants are aided by manipulatives which help to Destructure Patterns. Facilitators will typically fill the roles of Linker and Reflector, while participants are invited to take on the roles of Analyst, Time Traveler, Wrinkler, and Stepper. We aim throughout to Increase Participant Control, which can extend both to participant co-design of the workshop experience itself (supported by the patterns presented here), and to subsequent phases of work taking place after the workshop that gather, process, and organize additional data.

B.3 Worldview: ways of knowing and alternative discourse

Our methods express and communicate a worldview which works across contexts to support Scaling and Adaptability, offer Engagement and Guidance, and help with Avoiding Mistakes. Our work is informed by Causal Layered Analysis and other structured methods, however we encourage participants to Adapt Layers As Needed. One of the key purposes served by this paper is to articulate a range of re-usable and re-mixable methods that can be employed across sensory, cognitive, and motor domains. The actions considered within an Open Future Design workshop receive preliminary testing and development inside the workshop itself: The Future Begins Now. We encourage participants to Pilot to Anticipate beyond the workshop. Taken together, our perspectives are linked with the ethos of Peeragogy or "peer produced peer learning". Domain-level issues may (usefully) mirror the workshop's process-level patterns.

B.4 Myths: metaphors and narratives (longer term change)

We have flagged Going Meta as the primary metaphor of this work, in line with the series title, "Patterns of Patterns". The point is not to be 'meta' just for the sake of it, but to find the commonalities that reoccur across contexts, to build bridges between different communities, and develop a reflective workflow that can be improved as we go. A suitable metaphor is found in the example of a wheel that rolls more smoothly on round ball bearings. This metaphor helps to express the role that "Patterns of Patterns" play relative to patterns themselves:

> Technological progress is achieved through a dialectical relationship between mediation (adaptation to the end terms: the path to be travelled and the load to be carried) and autocorrelation, the relation between the technical object and itself. [Simondon 2005]

As a useful point of comparison, we observe that the "hierarchical generative model capable of self-access", from Albarracin et al. [2023], arises through the addition of reflective meta-layers, ascending from:

	"*What am I trying to do?*"	and	"*What am I perceiving?*"
to:	"*What am I paying attention to?*"	and	"*What am I trying to pay attention to?*"
to:	"*How aware am I of where my attention is?*"	and	"*Am I trying to maintain awareness of my attentional state?*"

Although the language is different (cf. Adapt Layers As Needed), an analogy between these three layers and the litany, system, and worldview layers of CLA could be noted. Towards a theorization of social intelligence, by applying PLACARD to itself (as it were), Going Meta allows us to *reflect* on our intention, *understand* where we are in the process of development we outlined, and *articulate* a way forward.

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