Prototyping adaptive automotive UX: a Design Pedagogy approach

Students derive a scenario from a technological, societal, industry and policy parameters matrix, situated in a studio practice, enabled by pedagogical method.

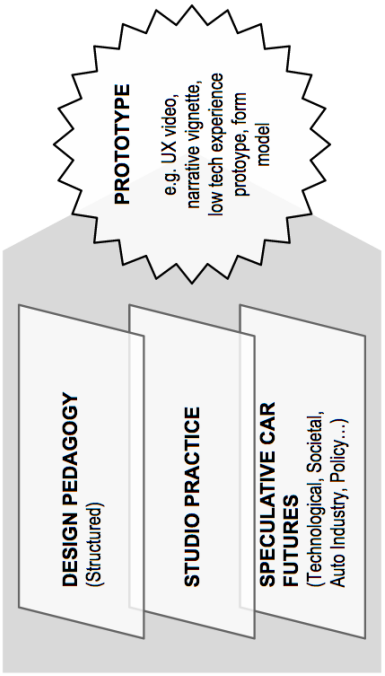

Figure 1 - constituents of the design brief

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Abstract
This paper outlines and evaluates experiential prototyping for emerging vehicle UX design within a pedagogical framework. Drawing from studio experience, we discuss the learnings, options and risks that in-vehicle UX designers face in prototyping real-time, adaptive user interfaces, and suggest methods and solutions for designers wishing to expand their creative practice.

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Prototype, interaction, HCI, pedagogy, UX.

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H.5.m. Information Interfaces, evaluation/methodology, Experimentation, Human Factors, Simulation, Design.

1 Introduction
The automotive user experience (UX) designers' work is driven by the emergent market of connected vehicles and cloud services, and specifically the future of vehicles as communication hubs for drivers and occupants i.e. assisted driving, infotainment. The wide range of possibilities, requirements, unidentified interaction models and scenarios, however, present a complex landscape to evolve UX design.

Over the course of one year, graduate and undergraduate students from Art Center College of Design worked with technology and automotive partners to develop a series of future car experiences. Of interest to us was the observation that without the institutional biases of industry or technology actors in the automotive space, students showed a marked aptitude for investigating experiential futures. This paper draws from the program's experience. Our approach synthesizes pedagogical methodology, studio framework, and strategic prototyping processes. [1]. We explore the challenges of prototyping real-time, adaptive user interfaces and present a set of tools and methods we believe may be valuable to industry

The educational creative framework mixes 'hard' and 'soft' programming.

'Hard' programming = timetabled events

- briefings
- lectures
- expositions and critiques

It punctuates the creative process as an essential prompt to students to externalize and make tangible, their thoughts.

'Soft' programming refers to environmental stimuli.

- informal displays of work
- proximity to prototyping spaces/labs
- open-ended work-sessions
- informal student-to-student mentorship

This *designed* creative culture differs from the generic ideation environment blank whiteboards and, post-it notes. Managing a balance of hard and soft time means students have the latitude to follow their own curiosities instead of executing a series of design exercises.

designers wishing to produce innovative and disruptive interactions based on core values of human-centered design. The rest of this paper is as follows: section 2 introduces our teaching approach. Section 3 provides exemplary student work following the design process outlined in section 2, and section 4 highlights the risks of "design thinking by making" in prototyping.

2 In-vehicle UX design from a teaching perspective

Emphasis on adaptive ambient displays as well as cognitive and socio-cultural contextualization with students, has led us to conceive of human-centered design practice as the connective tissue between multiple domains, methodologies and practices. The automotive industry is already familiar with "design thinking" but may find value in the concept of "design making" or "design thinking *through* making" [2]. New technologies in themselves are complex manifestations of social, economic, and political factors [3]. Successful design pedagogy encourages both self-reflection and critical exchange between student and material. Great flexibility is required to move between issues at the macro and micro levels, and between constraints and opportunities. Moreover, prototyping techniques demand that students' work transition from the speculative to the specific. The role of the educator is to identify tangible intersections, guide the process, and teach techniques such as storyboarding, paper prototyping, and Wizard-of-Oz (WOZ) as applied to automotive.

2.1 Setting up a productive space for creative making

Our curricular model frames an environment for creative thinking and making to co-exist symbiotically. The prototype, or probe, reflects disciplinary expertise, rigorous skill-building, advanced conceptual reasoning, and attention to both process and execution. A designer's work is not directional but dimensional, i.e. does not begin with a single version of a final outcome subsequently prototyped until completion (production design). Rather, the designer innovates by nimbly moving from one form of output to another, raising issues and communicating with acuity and clarity (iterative/generative design).

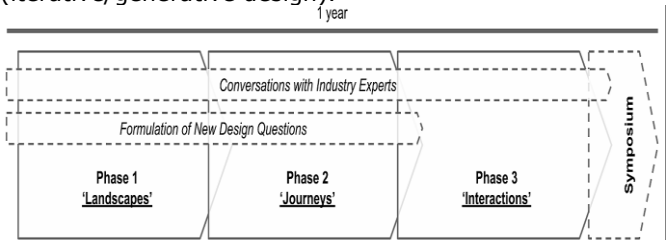

Figure 2. Phases of the project

2.2 Creating a Project Brief

A list of deliverables in desired formats does not constitute a creative brief. The project, therefore, is effectively to *define* a project and circumscribe the parameters. As a general starting point, we investigated situations, capabilities, and possible design opportunities 10+ years into the future [5]. Our investigation was specific: what will be the occupant experience in these vehicles? The project was split into phases, each phase in turn yielding a new brief for the next phase. Different students participated in each phase. Just as in industry, they "jumped onboard" ongoing projects and had to acclimate quickly.

In phase 1 we scoped widely by collecting, organizing and annotating inspiration material from diverse sources often tangential to automotive UX design.

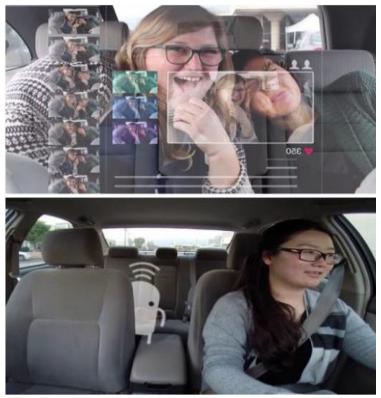

Figure 3 - Elaine Cheung & Shan Shen (top) and Nan Wang used video sketches to explore how other presence, in the form of an artificial assistant or other road users, could manifest alongside car occupants.

Figure 4 - Nick Meehan & Selwa Sweidan used improv. and pared-down staging to imagine new interpersonal interactions across multiple vehicles.

This became an Inspiration File. The purpose of the inspiration file would be to provide an important "agitative" resource for subsequent phases. (artcenter.edu/mdp/research/nce). To compliment this secondary research, we conducted in-car experiments by using "the journey" as a research space. During road trips, research assistants and students used inexpensive in-car tech to assess the qualities of various contextual mediations between people, devices, and vehicles.

2.3 Programming the Creative Process

Throughout all phases, we held regular conversations with experts, and invited industry leaders, and participated in interviews, workshops, and symposia. These dialogues not only capitalized on interdisciplinary research, but also fostered a healthy irreverence from students. The more stakeholders they interacted with, the more conflicting inputs the students were exposed to; yet the need to reconcile the inputs led them to focus on, and become advocates for, the end user.

3 Design Thinking by Making

Prototyping is fundamental to the design process; creativity takes place as much in making as in moments of reflection [6]. Below, some of the tools used by students are described. Before grounding a fixed context, students created sketch vignettes articulating possible occupant experiences. They concentrated on interactions between people (drivers, passengers, pedestrians), vehicles, devices, buildings, and cities. Students analyzed nascent technologies and hypothesized how their adoption could provoke new social situations, then validated these with users and experts. Students were explicitly asked not to make their films 'look professional'; the goal was to convey instances of novelty, delight, drama, or tension. These instances were then used as short cuts for "nascent novel edge cases" becoming the brief for the next phase.

In phase 3, following the generation of vignettes, students detailed and contextualized these user stories, illustrating sequences of user - system interactions of significant relevance. Paper prototypes manipulated to mimic the target system were then used to prompt users to perform realistic tasks without extrinsic explanations.

3.1 From Wizard of Oz to Micro-interactions

Given our emphasis on adaptive, ambient UX, both speculative narrative and specific micro-interactions uncovered details of nomenclature and signifiers. While car companies have traditionally tried to render processors, sensors, interfaces and mechanical platforms invisible, hierarchies across these systems are being disrupted. Functionality and UIs evoke deep relationships with other connected technologies (e.g. mobile devices) and their role in users' lives. Badges, labels, buttons and switches offer tangible points of interaction and sites of emotional response, but only resolve a small portion of a whole that is not yet familiar.

4 Learnings & insights on prototyping automotive UX experiences

In selecting a powerful generative tool such as a prototype, design *thinking* becomes design *strategy*. Designers, however, should be mindful of certain risks. The level of fidelity and ensuing UX are partly dependent on design resources. Although technically feasible, without research and a test strategy, the UX

Figure 5 - Angela Dong, Sarineh Issagholian, Vivia Liu and Thokozani Mabena's investigated a new kind of animated car seat as the primary interface for controlling a self-driving vehicle. Their protoypes were low-tech, but *experientially* very precise.

Figure 6 - Ken Hong, Bryce Johnson, Ravi Patel, Retro Poblano, Hari Ramachandran and Kunwar Walia made extensive use of 'Wizard-of-Oz' prototyping in their project.

researcher might be tempted to treat insights and observations as structured, empirical data. There is an incipient risk of extrapolating generalities from anecdotes and ad hoc feedback. Furthermore, study participants can easily misunderstand the purpose of prototypes and create mental models and expectations divergent from the core test hypothesis.

Selecting or designing the optimal tool also faces an inherent risk on commercial applications, when actual designs are operationalized. These prototypes must clearly express the occupant user experience as a way to produce clear requirements for final implementation, but also drive user insights as an integral part of the greater adaptive UX development strategy.

4.1 Pursuing the Minimum Viable Prototype

Analogous to Agile development, a UX designer is responsible for maximizing the return on investment on any prototype; this includes managing resources (time, material, technology and skills) and identifying the right level of fidelity and scope for each phase. A successful designer is therefore in pursuit of the minimum viable prototype (MVP). Some risk lies in treating a prototype as a demo tailored to showcase the most visually compelling idea, and the technical prowess of the team to gain sponsor support. MVPs do not serve the same purpose as a product vision or promotional video. In our approach, a vignette became an MVP when the designer embodied the design concept as an "informant" -- quite literally as an actor (Figure 6). Video exemplifies user stories at their simplest, and works both to interiorize user-centered design concepts and express a design vision in a clear tangible way.

By setting up a creative environment, diligently programming the creative process and strategically choosing prototyping tools, our students created exciting opportunities to pioneer adaptive in-vehicle user experiences. In future studio programs we hope to integrate more extensive usability practices and innovative generative design techniques that can be shared by other practitioners.

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