Future *Tense*: Harnessing Design Futures Methods to Facilitate Young People's Exploration of Transformative Change for Sustainability

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Abstract

The research starts from the premise that as the world is changing rapidly and in nonlinear ways, we are educating future practitioners for jobs and contexts that don't yet exist. They instead need to be equipped to work for and with uncertainty to be able to grapple with the scale and pace of emergent change. The fields of design and futures studies bring significant insights to this challenge, including an array of methods, tools, and frameworks for prospective and systemic explorations of alternative futures. The emerging field of design futures can be framed as ways to develop and deploy prompts, artifacts, and narratives to critically interrogate tomorrow's societal debates today; as such, it is intentional from the outset in its pursuit of preferable futures and therefore social and environmental justice. The process of imagining the future is an active, values-laden social practice, which requires a layered approach to a methodology to surface and challenge dominant patterns—making it an ideal approach for training the young people who will shape our future. This article reports on the design and delivery of participatory workshops that employ design futures methods to facilitate the exploration of transformative change for sustainability. These workshops were conducted with young people aged sixteen to seventeen to equip them to develop and explore alternative futures. The results suggest that design futures methods can facilitate participants from non-design backgrounds to develop alternative futures and artifacts that might sit within them. It was found that developing a sense of ownership was key to enabling participants to effectively reflect on alternative futures and their implications. Finally, the study highlights the potential for these methods to inform both design and sustainability pedagogy.

Introduction

Active stewardship of the Earth System will require transitioning our current unsustainable lifestyles, socioeconomic system, and social practices through new methods, tools, and narratives (Steffen et al. 2018). Tackling these challenges means creating a diverse set of

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interventions spanning local contexts and global narratives, as well as the operating beliefs and norms which enable societies to function. One such intervention point could be situated in the early stages of worldview development, working with young people to explore possible, preferable, and probable alternative futures (Bell 1998). Young people have long been perceived as drivers of attitudinal and cultural change. Recent research has started to explore "how changes in social structure affect their endeavour for constructing identity and making their preferable future images reality" (Kaboli and Tapio 2018) and an increasing research interest is presented by young people's images of the future (Rubin 1998), as well as their ability to be critical drivers of social change (Ho et al. 2015).

The purpose of the educational system, and specifically, of project-based learning, is to equip young people for the complex conditions facing them as "citizens in a global community" (Torp 2002). There have been increasing calls to prepare "Earth-literate leaders" (Martin and Jucker 2005), through enabling young people to develop capabilities that strengthen their resilience to the unknown unknowns of tomorrow, rather than operating within the parameters of current knowns and known unknowns.

This research aims to explore how futures and design methods can be used to facilitate young people's understanding of current sustainability challenges and the transformative change they require. It seeks to investigate whether experiential project-based learning can provide an appropriate method to create the setting to test what working with and for growing uncertainty about our global future(s) might look like. As part of this research, this article describes the design and execution of a series of workshops in which these methods were explored during three week-long Global Summer School (GSS) at Imperial College London in 2017 and 2018. This article reports on the development of these workshops with the aim of sharing experiences with sustainability-led learning experiences that draw on tools from across design and futures studies. It discusses challenges and successes with the workshop design, highlighting iterative changes made to help facilitate improved learning and reflection. It builds on previous research undertaken by the authors with postgraduate design students and early career designers into the role of alternative futures as a design method in enabling systemic approaches to sustainability transitions (Angheloiu et al. 2017). The future visions surfaced during these workshops will be analyzed and discussed in a subsequent publication.

The cohorts taking part in the research are aged sixteen to seventeen, which is a timely moment considering they are exploring future career pathways and are in the midst of testing options for further education. Enabling them to consider the wider changes happening in the world, develop fictional stories, scenarios, and artifacts, and reflect on the potential implications for their personal choices over the next years could provide the opportunity for a more tangible understanding of sustainability challenges and therefore the roles they might want to play in their future careers.

Background

The research seeks to test the hypothesis that design and futures methods can help develop a process of imagining alternative futures to prompt reflections about current sustainability challenges. Extensive research has been dedicated in the fields of design and futures studies to the potential of speculation and anticipation about societal futures to inform and incite change in the present tense.

However, speculation in the context of design is oftentimes perceived as art (and therefore not taken seriously in decision-making contexts in business, policy-making, and governance), while speculation in the context of futures studies is oftentimes perceived as strategy (and therefore rarely addresses non-experts); its failure to mobilize a wider audience has been coined as the "flatland of futures" (Slaughter 1996).

Moreover, despite the fact that both fields champion a participatory approach to their methods, many practitioners from both fields still perpetuate (inadvertently or not) the
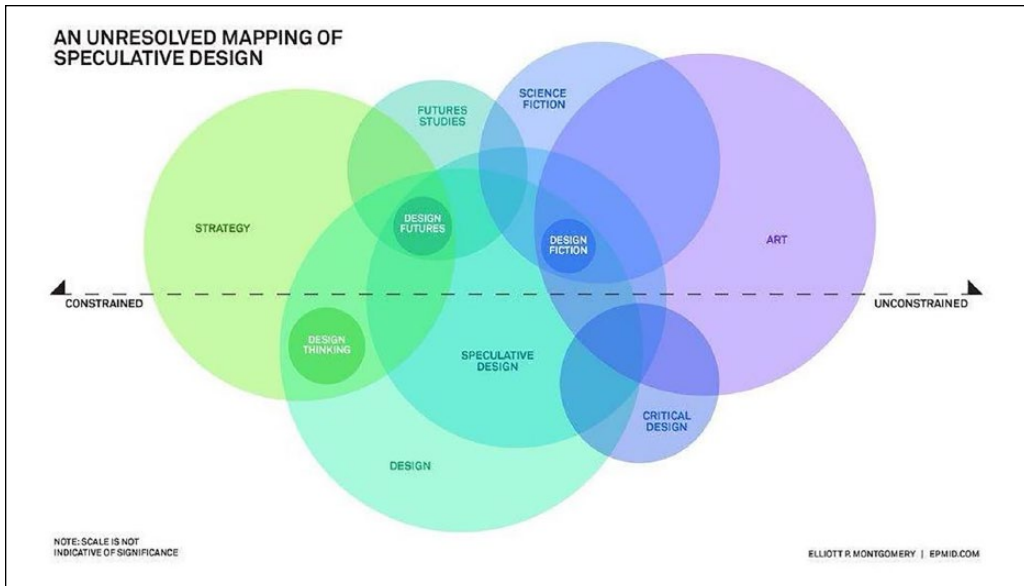
Figure 1. An unresolved mapping of speculative design (Montgomery 2018).

common trope of the expert as hero. Recent research is beginning to point that artistic forms of future thinking, such as science fiction, can have positive effects on enabling a transition toward sustainable futures (Gendron et al. 2017).

The following sections chart the potential to address some of these challenges and opportunities through the field of design futures, an emerging area of practice and research at the intersection of design and futures studies.

Tributary Sub-Disciplines of Design: Speculative Design and Design Fiction

The act of designing is in itself a process of bringing new ideas into form, of giving shape to hypothetical possibilities. With the advent of "designerly ways of knowing" (Cross 1982), the field of design has developed thinking and learning processes which enable people to deal with complex problems and uncertainty (Lawson 1980).

Elaborating on the concept of wicked problems as developed by Rittel and Webber (1973) with regard to urban planning, Richard Buchanan (1992) crystallized the role of design as an integrative field which provides methods for problem definition and problem solution. Coined as design thinking, his work depicted the potential of design to combine a deeper understanding of context through ethnographic methods, with the solutions-oriented bias of a design process. As Buchanan further notes, the subject matter of design is potentially "universal in scope" as it can be applied to any area of human experience.

Over the past decades, a multitude of subfields have crystallized with this belief at their core—from tangible product and craft-based disciplines, such as industrial design, to the more intangible realm of speculative design (Dunne and Raby 2013), design fiction (Lindley and Coulton 2015; Sterling 2005), or transition design (Irwin 2015).

An attempt to map speculative design can be seen in Figure 1.

As Dunne and Raby (2013) suggest, "design can allow an individual to open windows on the future in order to better understand the present." A more recent development in the fields of design fiction, speculative design, and critical design has been the approach to design as a practice focused not on solving problems

(and therefore outcome-oriented mindset) but asking "carefully crafted questions" (and therefore inquiry-oriented mindset) (Dunne and Raby 2013).

The implications of this subtle but defining shift in purpose ripple out across different dimensions. Traditionally, design has seen prototypes as "an early sample, model, or release of a product built to test a concept or process or to act as a thing to be replicated or learned from" (Blackwell and Manar 2015). However, the role of prototypes in inquiry-oriented processes is radically different; as coined by Bruce Sterling in an interview, "design fiction [sees] the deliberate use of diegetic prototypes to suspend disbelief about change" (Bosch 2012). The term "diegetic," stemming from the Greek diegesis (to narrate), seeks to explain how the viewer should relate to prototypes in this new form of design. Diegetic prototypes are props to help the viewer "make-believe" and explore the critical questions the corresponding fictional world and its prototypes are aiming to stir as reaction.

Images of the future and their diegetic prototypes have the potential to "shape the collective imagination" (Wakkary et al. 2013) and potentially "[plant] a seed that reveals itself in the distant future" (Draudt et al. 2015).

Futures Studies

Central topic in the field of futures studies is the premise that by imagining different, alternative futures to the current business-as-usual scenario, we stand a better chance of bringing them into being (Dator 2002; Fuller 2016; Miller 2010; Rosen et al. 2012).

In contrast to speculative design and design fiction, futures methods have long been used in business and policy-making and are practices in industry and government as strategic foresight, an area of practice within the futures studies field (Voros 2001). Methods for imagining alternative future pathways emerged during the Cold War within the U.S. military-industrial sector through organizations such as RAND or the Hudson Institute—themselves legacies of the World War II apparatus (Bell 2003). These methods diffused

into other industrial sectors over time, most notably through initiatives such as the Royal Dutch Shell Scenarios (Schoemaker and van der Heijden 1992) and the Oxford Scenarios Program (Said Business School n.d.).

However, the "pragmatic foresight" (Voros 2001) Shell practice of scenarios has little to do with the transformative goal stated in the first sentence of the section. Its value proposition lies within actively managing current market conditions, supporting innovation management processes and therefore minimizing risk to the current status quo. It provides links between corporate strategy, innovation, leadership, organizational learning, investment, and marketing and communications, with the core assumption that the organizations engaging in strategic foresight will gain the capability of being "future fit" and therefore gain a competitive advantage.

Strategic foresight and futures studies might share a suite of methods and tools, yet their goals are inherently different: one is to preserve and reinforce the status quo, while the other is to inquire and actively explore alternatives to the status quo. It is the latter goal and its associated methods and tools which are of interest to the study undertaken here.

Much like the fields of design, futures studies is often portrayed as a capability exclusive to experts, while in fact a participatory approach is a core value for both fields; in both cases, it builds on our innate human capability of (1) anticipating the future and (2) shaping our environment to respond to perceived threats and opportunities. Challenging the misconception that "professional experts" are the only ones who can tackle long-term and large-scale problems, new tools are emerging to popularize and lower the barrier to entry to both design (Manzini and Coad 2015) and futures methods (Montgomery and Woebken 2016). However, enabling non-experts to act on the deeper aspects of future-oriented sustainability challenges requires a better understanding of the challenges and the implications they might have for tangible everyday experiences in the future such as: How will we make decisions? What will we eat? How will we stay healthy? and How will we move around?

In this context, scenarios are one method commonly used to help expand our "possibility space" by encouraging speculation of multiple and widely varied alternative futures (Miller 2006) and can offer new potential for education. Widely used across strategic foresight and futures studies, the scenario development process (Voros 2001) has a wide range of applications and specific uses from the highly quantitative approach of the IPCC scenarios to the more rapid generation of scenarios through the selection of uncertainty axes. However, evidence gathered by Gregory and Duran (2001) in the development of scenarios by either researchers or research participants with or without structures guidelines has shown that,

> Regardless of how scenarios are created, they [nb. scenarios] alter people's expectations about the depicted events. Evidence suggests that the ease with which a scenario is imagined or constructed, or the plausibility of a scenario, upwardly biases beliefs that the depicted event could occur.

While scenarios are a structured method for probing the future that evolved over the past four decades, recent developments in the field of futures studies have seen the proliferation of new methods that build on emergent systems properties and bridge the "experiential gulf" (Candy 2010) between abstract futures as explored by scenario planning and the reality of everyday life in the present. Candy maps this knowledge gap and advocates for an "experiential turn" to enable people to experience alternative futures in the present tense, through immersive methods. One such approach is Ethnographic Experiential Futures or EXF (Candy and Kornet 2017), a "design-driven, hybrid approach to foresight aimed at increasing the accessibility, variety and depth of available images of the future"; it seeks to do so through the development of narratives, fictional artifacts from the future, and experiential scenarios (that can be performed or enacted).

These methods do not and should not offer definitive answers as to how the future will look—instead, they are useful devices in enabling people to better understand the challenges we are faced with and spark reflection about implications at a personal, collective, and societal level.

Design × Futures = Design Futures?

As explored in the sections above, the fields of future studies and design have developed a myriad of approaches to speculate about possible, probable, and preferable alternative futures. While the purposes and methods of the sub-disciplines are actively debated, the last decade has seen an increasing interest in the intersection of design and futures.

The approaches championed by speculative design, design fiction, or critical design are now common within design institutions; however, the resulting artifacts sit more closely in the realm of art, intended to provoke conversations in the context of exhibitions in design schools, museums, and galleries. However, foresight has a long-standing history in business and policy-making, where their corresponding methods are deployed mostly in strategy development and in the research and development cycle of innovation.

The current state of play opens the possibility for these complementary approaches and methods to be put to use in the context of exploring transformative change in line with the social and environmental challenges of our time. The use of design and futures methods to develop a prospective and systemic exploration of transformative change is a new area of exploration which enables conversation about the paradigm shift required in the context of the values, ethics, and societal norms.

Figure 2 builds on Montgomery's (2018) mapping of speculative fiction, in the desire to test the relationships between the different sub-disciplines across two axes—attitude toward strong sustainability (Daly 1991; Turner 1993) and attitude toward change. While strong sustainability acknowledges that natural capital cannot be replaced by economic or social capital (and that they are nested systems), the transformative attitude to change axis implicitly requires a paradigm shift beyond the current socioeconomic system to stay within planetary boundaries.
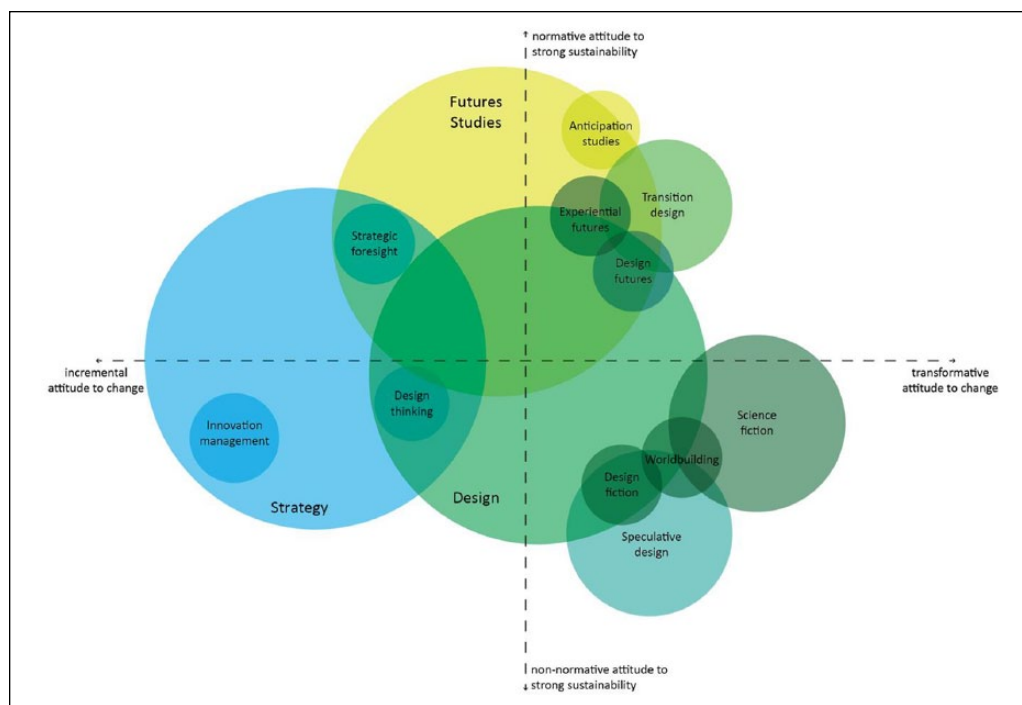
Figure 2. An emerging map of design futures: Attitudes toward change and strong sustainability.

Building on the literature explored above, an emerging definition of design futures could be framed as ways to develop and deploy prompts, artifacts, and narratives to critically interrogate tomorrow's societal debates today; as such, it is intentional from the outset in its questioning of the dominant paradigm in the pursuit of preferable futures and therefore social and environmental justice.

Methodology

This section describes the workshop design process, highlighting the methods used, and situates these workshop prototypes in the context of the Imperial College GSS. The research has been undertaken during August 2017 to September 2018, during three separate week-long workshops.

The Imperial College GSS

The research has been conducted as part of teaching in the GSS at Imperial College

London in the summers of 2017 to 2018. Each year, 200 secondary school students from all over the globe attended four different academic tracks, out of which 105 students joined the three iterations of the "Future Visions" track.

The GSS attracts highly competent and confident science, technology, engineering, and mathematics (STEM)-oriented students, where most are aspiring engineers and medics from affluent, globally mobile backgrounds. The learning outcome of the summer school is to develop skills such as presenting, communication, and group work through four tracks that focus on real-world challenges that our society faces.

Within that framework, the learning outcome for the Futures Visions track is to engage students in the application of interdisciplinary and systemic thinking about uncertain futures through experiential learning, thus giving them a taste of the various decisions and implications they will likely encounter during their future careers. In this way, the project was also
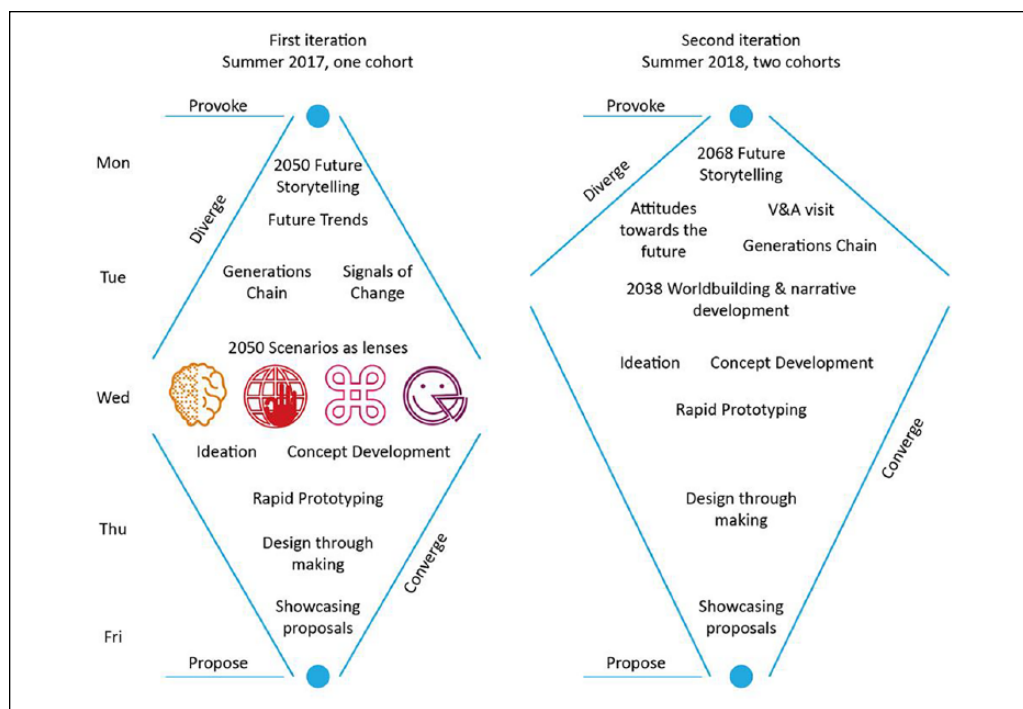
Figure 3. Process diagram showing the differences and similarities between the iterations of the Future Visions track.

designed to help explore new modes of sustainability education to equip the practitioners of the future, by bringing together design methods such as speculative design and foresight methods such as scenario explorations to cultivate prospective thinking.

Future Visions Summer School Design: Two Iterations

The brief for the two iterations of the Future Visions track was to develop future artifacts related to what different aspects of lifestyles might look like in 2038 or 2050, respectively.

In the first iteration in 2017, the artifacts were developed through the exploration of a set of 2050 scenarios for sustainable lifestyles (Leppänen et al. 2015). In the second iteration in 2018, the artifacts were situated within scenarios developed by the participants through the extrapolation of present-day trends, as well as visual storytelling and narrative building exercises. Figure 3 illustrates the main differences and similarities between the respective

iterations, where each iteration had two halves: using futures tools in the early part of the week to promote divergent thinking and design tools in the second part of the week to promote convergent thinking. However, for each of the weeks, the pace and individual tools employed were adjusted.

The Summer School design started by surfacing the participants' attitudes toward the future; in the 2017 iteration, they were then asked to imagine the world in 2050 and the role(s) they will have played through their careers, while in the 2018 iteration, the participants completed an attitudinal survey developed by the polling organization YouGov for the V&A Museum (YouGov n.d.), as well as writing a short story about the world in 2068 and relating that to the roles(s) they will have played through their careers.

Following these upfront future-casting exercises, in both iterations, the participants then mapped generational change by looking at the hopes, fears, and major events of their grandparents', parents', children's, and grandchildren's

generations, as well as their own through a futures process titled the Generations Chain (Slaughter 1996).

These upfront methods framed the rest of the summer school. In the 2017 iteration, the participants then explored current trends shaping the future and then delved into a set of 2050 scenarios (Leppänen et al. 2015) through developing quick glimpses of life in 2050 in the different scenarios, which were then role-played in teams. Following this warm-up exercise, the teams were allocated one scenario to work within for the second half of the week. In the 2018 iteration, the participants developed a suite of detailed 2038 worlds by working through a set of exploratory questions (such as "How do we make decisions? How do we find love? What is on our dinner table?"), as well as a visual storytelling exercise based on collaging techniques to develop a coherent narrative for a 2038 world of their choice. The 2018 cohorts were fortunate to coincide with a major exhibition at the V&A Museum titled "The Future Starts Here: 100 objects changing the world of tomorrow" (Victoria and Albert Museum n.d.), so both cohorts visited the exhibition to be inspired.

Following this exploratory stage, both iterations of the Future Visions track followed the same process of ideation, concept development, and rapid prototyping. Reflective sessions were interspersed through the summer school to surface emerging reflections on both the activities undertaken and the participants' perceptions toward the glimpses from the future they were creating through their artifacts. The templates and tools used have been open sourced (Angheloiu et al. 2018).

In the first iteration, the students were asked to produce (1) an artifact exemplary of their 2050 scenario and (2) a one-minute video bringing the artifact to life and showing it in context, while in the second iteration, the students were asked to develop the artifact exemplary of their 2038 world and situate it within their speculative future through their verbal presentation.

Design and Discussion of the Methods

This section describes the design of the methods, as well as key reflections and insights from both participants and researchers about the methods. The analysis is presented in chronological order of the different phases of the week-long module.

Table 1 depicts the different phases of the process, as well as the methods that were used and the data collected throughout the study.

Context Setting Phase

Attitudes toward the future

Method description. Surfacing the attitudes toward the future was done through an attitudinal survey about the participants' expectations about the future. The survey design followed the same format as the survey presented in the V&A exhibition "The Future Starts Here," which was designed by YouGov. The survey conducted by YouGov (n.d.) asked the public ten questions which covered four categories: "optimism vs pessimism; feelings of powerfulness vs powerlessness; technophobia vs technophilia; and disruption vs continuation." From their research, six distinct attitudinal groups emerge: Excluded Pessimists, Well-informed Worriers, Insulated Stragglers, All-round Optimists, Empowered Hopefuls, and Tech Disciples (Figure 4).

The attitudinal survey (see the appendix) about the future was undertaken as a first exercise during the week-long workshop, to situate the attitudes toward the future in the context of a wider survey sample (as gathered by YouGov through the V&A Future Starts Here exhibition).

Participants' reflections. The participants enjoyed the immediate feedback they received from the survey, as they found out which "archetype" they fitted in. The format allowed for an interactive discussion between the participants as they were curious to see what archetypes their peers fell into. Anecdotally, the Excluded Pessimists were the keenest to know more about how the survey was constructed and what this might mean for the choices they're making ahead.

Facilitators' reflections. From a facilitators' and researchers' points of view, the survey

Table 1. Methods and Data Collection in the Two Iterations of the Future Visions Track.

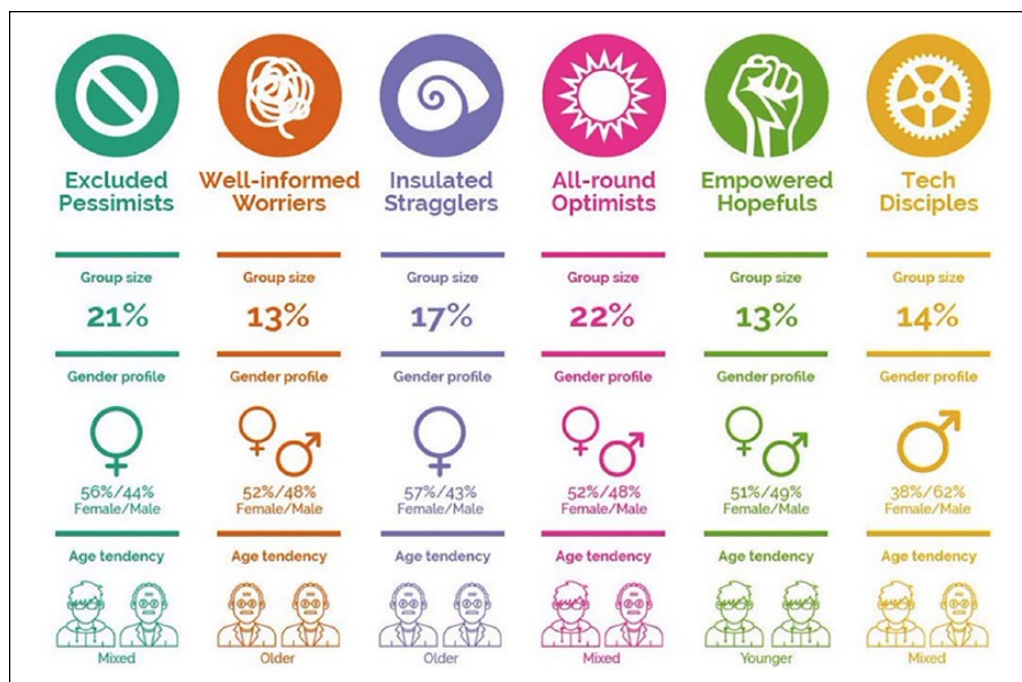| Phase of the week	Iteration 1	Iteration 2
Context setting	**2050 Storytelling** *Data collected*: participants were asked to write a short story (100–150 words) about the world in 2050 and their role/legacy in it. *Purpose for collection*: situate the participants' current understanding of sustainability challenges and archetype for the future they are imagining (through narrative mapping onto Dator's Four Futures archetype model) (Dator 2002).	**Attitudes toward the future** *Data collected*: an attitudinal survey based on the survey designed by YouGov for the V&A exhibition "Future Starts here." *Purpose for collection*: data triangulation—situate the attitudes toward the future in the context of the wider UK population and validate the stories through analyzing for consistency or difference. **2068 Storytelling** *Data collected*: participants were asked to write a short story (100–150 words) about the world in 2068 and their role/legacy in it. *Purpose for collection*: situate the participants' current understanding of sustainability challenges and archetype for the future they are imagining (through mapping onto Dator's Four Futures archetype model).
Exploration	**Generations Chain** *Data collected*: hopes, fears, and major events from grandparents' to grandchildren' generation. *Purpose for collection*: analyze key generational milestones as well as the collective imaginary for the future generations and situate processes of change within a familiar, tangible context—one's own family. The Generations Chain was built on a wall in the workshop space and used throughout the week to situate the different activities in their respective time horizons.	
	2050 Scenarios exploration *Data collected*: no data collected of the 2050 glimpses.	**2038 Worldbuilding** *Data collected*: future worlds generated (written and visual storytelling). *Purpose for collection*: situate the future worlds developed by the participants on Dator's Four Futures archetype model and analyze the types of future imaginaries they developed.
Provocation: proposition development	**Artifact development** *Data collected*: fictional artifacts from the future. *Purpose for collection*: to critically analyze the implications at a personal, collective, and societal level should these fictional artifacts become reality; data are analyzed against three categories based on Donella Meadows' (1999) Leverage Points: product–service interventions, structural rules and goals, and the dominant paradigm.	
Reflections	**Final reflections survey** *Data collected*: final reflections survey. *Purpose for collection*: to understand whether the workshop overall and the individual methods used have enabled participants to understand sustainability challenges better and whether they have sparked personal reflections.	

Figure 4. Six attitudes toward the future as identified by YouGov research.

achieved two important objectives: (1) to provide a warm-up activity to help ease people into the week ahead and (2) to help situate the attitudes of the cohort through gathering a dataset to be analyzed. The researchers chose to use the same survey as the YouGov one to be able to compare the data with a wider data pool, yet the technical aspects of using the YouGov survey and issues around ownership of the data entries mean that in the future, the researchers will set up a mirrored survey on an independent platform to take place at the beginning and at the end of the summer school to see whether attitudes shift at all during the week.

Envisioning 2068

Method description. Following the attitudinal survey, the participants were asked to write a story about the world as they imagine it in 2068 (when they would be approximately sixty-seven to sixty-eight years old) and describe the role they would play in that world. The 2068 milestone was the furthest away point the participants looked at throughout the week.

The stories were then mapped onto a model developed by Jim Dator (2009)—the Four Generic Futures which observes that the narratives we develop about the future can be classified into four recurring archetypes: Grow (business as usual, continuation of status quo), Discipline (behaviors to adapt to internal or external limits); Collapse (system degradation or failure); and Transform (game-changing new models or factors). It asked the following questions:

- Imagine the future in 2068 (you'll be sixty-seven to sixty-eight years old) and tell us a story about how we got there.
- What role do you play in this story?

Participants' reflections. The participants enjoyed this exercise as it allowed for a different kind of participation, which is particularly helpful for the more introverted. Group exercises and team work can sometimes be exhausting as well as rewarding, so creating a mix of ways to contribute was something that

Table 2. Generations Chain categories.

	Grandparents	Parents	Me	Children	Grandchildren
Hopes					
Fears					
Major events					

Figure 5. The generations chain mapped on the wall.

the participants commented positively on in the final feedback.

Facilitators' reflections. Conducting this exercise upfront allowed the researchers to surface the images of the future that participants held prior to the summer school. The stories themselves showed a great display of imagined futures, as well as acute awareness about current trends and research around climate change. Scanning through these stories upfront in the week allowed the facilitators' team to adjust the content and the level of depth that was gone into through the conversations and exercises that followed. A potential addition in the future is to enable participants to take their imagined futures as a starting point for the worldbuilding exercise, or at a minimum to share their imagined future with one or two other people and discuss the different visions.

Exploration Phase

Generations Chain

Method description. Following the first set of exercises, the participants mapped generational

change over the past century since their grandparents' generation and casted the net into the future through to their (potential) future grandchildren. The Generations Chain is a futures method which argues that,

> in order to obtain a grasp of our own context in time, we require a notion of the present which recognises that we are: 1. rooted in the past, 2. responsible for creating our near-term futures, and 3. also responsible for protecting future generations. (Slaughter 1996)

The mapping exercise consists of depicting the hopes, fears, and major events over five generations as experienced and anticipated through a personal lens: the participant's own family (Table 2; Figure 5).

Participants' reflections. This exercise stirred lively conversations throughout the three summer schools, with participants finding personal histories to be an approachable entry point to think about global events or issues of the time. The historical, yet personal, lens provided the context for conversation about how more abstract processes of change happen around
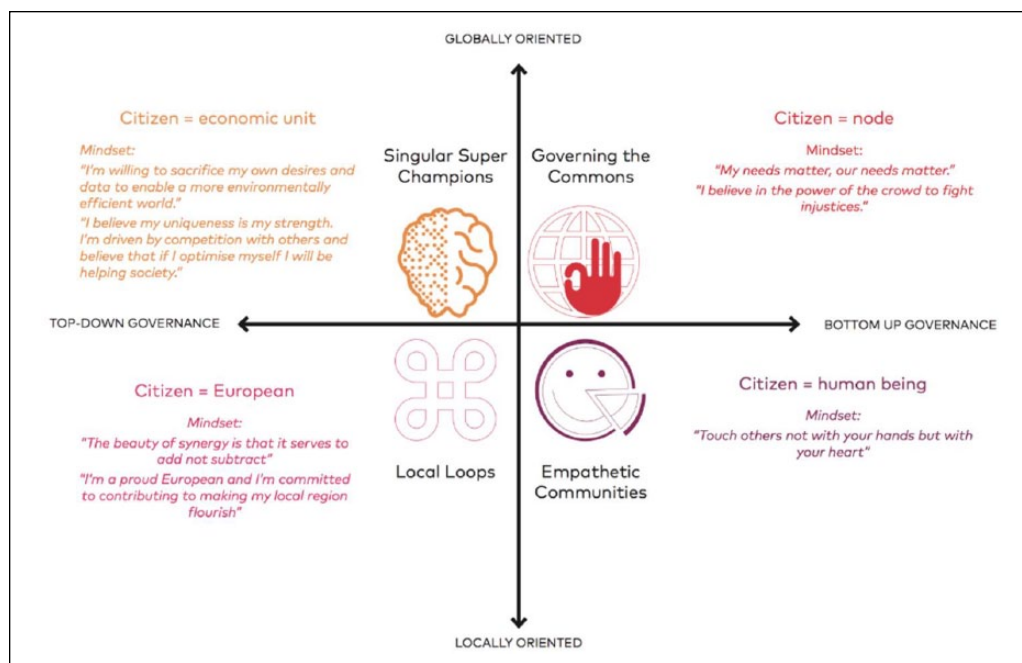
Figure 6. SPREAD 2050 sustainable lifestyles scenario axes and dominant mindset.

us, as well as the timelines within which societal and environmental changes unfold.

Facilitators' reflections. The Generations Chain exercise enabled participants to reflect on issues of path-dependency and the preconditions that would need to be true today for their hopes for their children's and grandchildren's generations to become reality in the future. The individual historical timelines formed a visual aggregated history to which participants referred back when developing or exploring their worlds and artifacts and to which facilitators could use in tutoring and discussion to refer back to. This was particularly helpful when reminding the students that their hopes and concerns for the future were often centered on more human aspirations, as opposed to technological developments.

2050 Scenarios Exploration

Method description. The "SPREAD Sustainable Lifestyles 2050" are a set of scenarios developed by a consortium of experts led by the UNEP/Wuppertal Institute Coordinating Centre on Sustainable Consumption Produc-

tion which depict four different pathways to achieving a substantial reduction in European carbon footprints. The participants were facilitated through an improvisation exercise, whereby small teams enacted a glimpse of what it would be like to be alive in the four different scenarios in 2050, based on a limited set of scenario information (the axes, mindset, and headlines). They then received a set of visual cues describing the pathways to 2050, as well as the state of the world in each of the scenarios. This enabled them to explore the types of innovation needed to move toward a sustainable society by exploring the different pathways, and acted as a springboard for the artifact development process (Figure 6).

Participants' reflections. The participants struggled to develop ownership over these future scenarios that they were presented with, despite being given the background and process behind how these scenarios were developed. This raises methodological issues as given the duration of the summer school it would have been impossible to achieve the development of a set of well-rounded scenarios that translate

quantitative indicators for footprint reduction into stories and narratives that create a holistic impression of what different future pathways could look like. Anecdotally, many participants also struggled with a perception that the only viable paths suggested a departure from individualistic paradigms (linked to capitalism) toward communitarian pasts that their own forefathers had transitioned away from.

Facilitators' reflections. From the perspective of the facilitators' and researchers,' using a set of existing scenarios that looked at what transformative actions might look like to be in line with the shifts required for sustainability felt like the obvious addition to the process design. We were initially surprised by the resistance they were met with by the participants, especially as they were previously used in a similar process with postgraduate students (Angheloiu et al. 2017), which had a completely opposite reaction—where the postgraduates found the scenarios to be a rich resource for exploration, and the summer school students felt trapped by them. However, we understood the need of young people for self-expression and not be "handed down things," which was a key reason for introducing a worldbuilding exercise instead in the second iteration of the summer school in 2018.

2038 worldbuilding

Method description. The participants worked together in teams of five to develop future worlds situated in the year 2038, which would form the context for their artifact. In parallel to this exercise, the participants also explored the current V&A exhibition, to get inspired and explore some of the themes and artifacts which are deemed to be currently shaping our future.

The teams were handed a series of worksheets to develop a narrative and visual storytelling about the world in 2038.

Participants' reflections. Unlike the previous iteration, the participants felt an acute sense of ownership over the worlds they developed, using first person pronouns throughout all the presentations (by repeatedly using phrases such as "in our world" and "our future scenario").

Facilitators' reflections. The worldbuilding and artifact development processes enabled participants to develop detailed pathways to 2038 and create the context for an artifact which would bring to life an aspect of their envisioned future. Despite the fact they felt ownership over the futures they developed, the facilitators were really struck by how much more homogenous these scenarios ended up being (as the cohorts were very diverse culturally, ethnically, and racially, this could be potentially linked to the socioeconomic makeup of the cohorts as globally minded and predominantly affluent).

Proposition Development Phase

Artifacts

Method description. Following the exploration of the 2050 scenarios or the development of their future worlds, respectively, the students were facilitated through a design process to develop an artifact which would exist in that world.

This phase included exercises around ideation, concept development, rapid prototyping, and "cardboard engineering" (Camburn et al. 2013; Jonson 2005; Neeley et al. 2013).

Participants' reflections. The participants hugely enjoyed this part in which they got to play with materials and bring their visions to life. In the post-workshop feedback forms, this phase has consistently been ranked as their favorite activity, which speaks to an action-oriented bias rather than an inquiry-oriented bias perhaps often associated with young people.

Facilitators' reflections. From a facilitators' point of view, in this phase, our role was to provide formative feedback throughout the design and making process and prompt the participants to think and reflect about what they are making, as well as give them the technical support they might need in the process of building. This was often challenging as these students were not used to team-working strategies such as having to negotiate decision-making with others and receiving this sort of informal critique and feedback from tutors.

Final Reflections

Method description. The final round of reflections sought to surface the impressions the summer school left them with, asking them what surprised them most, as well as inviting them to consider the implications the topics explored during the week might have during their careers:

- What surprised you most (about the week, your project, your team, yourself)?
- What do you think your projects and worlds might mean for your future careers as medics, engineers, biologists, etc.?
- After this week . . .

challenges. However, this presents itself as a possibility space for the field of design futures—as both a disruptor of hegemonic futures and as a vehicle to hold a mirror for reflection on the present lock-in of dominant Western imaginaries.

The methods presented above are not perfect recipes ready to be deployed regardless of

Optimist vs Pessimist *

	Very Pessimistic	Pessimistic	Neutral	Optimistic	Very Optimistic
How do you feel about the future of the planet?	○	○	○	○	○
How do you feel about the future of humanity?	○	○	○	○	○
Do you feel you personally can have an impact on the future?	○	○	○	○	○

Participants' reflections. By this point in the process, the participants were accustomed with the reflective moments of the workshop. Following them completing the final survey, a final discussion about their biggest takeaways from the process continued informally.

Facilitators' reflections. The final survey (as well as the overall survey conducted by the Imperial College summer school organizers) enabled us to learn from the feedback and the strong points from the process, as well as improve and iterate the weaker points. It has also enabled a comparison of how the various methods have impacted the students' perceptions and of how the different iterations impacted the participant's view of the future. In the second iteration of the summer school, the participants were significantly more invested in the worlds and artifacts they had developed; in turn, the personal reflections about what this might mean for their future careers demonstrated double-loop learning which questions the underlying assumptions, beliefs, and mental models (Cartwright 2002).

Conclusion

Considerable work is needed to nurture a plurality of future imaginaries, as well as ways of seeing and imagining to tackle key sustainability

context and audience. They have been developed with thorough consideration of what mix of methods might work best for the context of the summer schools, as well as our audience of young people with an inclination toward STEM subjects who might see themselves as future Imperial College students. The iterations the process have undergone over two years highlight the potential for a flexible network of such tools, methods, and props which could be deployed to both surface collective imaginaries and help create a safe space within which to interrogate them.

The largest change made between workshop iterations was to switch from using prescribed scenarios and pathways as a building block, to allowing the students to conduct their own worldbuilding. The future milestones were decided upon opportunistically—in the first iteration, due to the existing 2050 SPREAD scenarios, while in the second iteration, we decided to test the twenty- and fifty-year time horizon, as well as situate the conversation in concurrent time horizons with the V&A exhibition "The Future Starts Here." Through these two explorations, it was found that while students responded more effectively to being given the space to develop their own future visions, the cohort as a whole created more homogenous and less transformative in keeping with visions. This process iteration

poses a key question for reflection, which needs further testing and exploration, namely, how might we create a process through which people develop ownership over their preferred future vision, yet ensure those visions add up to the shifts that we know will be needed to stay within 1.5°C?

Overall, it was found that the key success factors were fostering a reflective environment and promoting ownership of the narratives developed. In the first case, through baseline setting using surveys and the Generations Chain which could be referred to throughout the rest of the design and development. In the second case, through enabling worldbuilding and giving the students the tools of design such as artifact development, role play, and prototyping.

A longitudinal study would have been ideal to explore the effectiveness of the methods; however, due to external constraints, such a process was not possible. The facilitators' reflections were included to enable other educators and practitioners to learn from our insights, as we believe that building young people's skills to work with and for uncertainty is both an urgent need and a promising intervention point toward equipping Earth-literate leaders.

The research presents three key future opportunities for development of the emerging design futures field:

- The potential to explore what a network/repository of interdisciplinary tools and methods might look like;
- The potential to explore the application of design futures methods for non-designers;
- The potential to further investigate the epistemological and ontological overlaps between the fields of transition design, experiential futures, and design futures. Further research is required to test and further develop design futures as an interdisciplinary approach to envisioning transformative change, as well as its relationships with transition design (Irwin 2015) and experiential futures (Candy and Kornet 2017).

The authors intend to further develop the methods described above and will be running modules at postgraduate level during the coming academic years with students from the dual degree (between Imperial College London—Royal College of Art) Global Innovation Design (GID).

The process design in its iterations suggests a strong use case for a blend of design futures methods to help surface collective future imaginaries and create the space to critically interrogate hegemonic futures, as well as inquiring into pluralistic alternatives. As one participant reflected, "this means we're making the future now"—an insight in equal parts daunting as well as empowering.

Appendix

Attitudinal Survey Questions

The survey asked the following questions:

- In twenty years' time, do you expect society to have become better, worse, or stayed about the same?
  - Much worse
  - Somewhat worse
  - Stayed about the same
  - Somewhat better
  - Much better
- How much do you trust or distrust those people and organizations that you believe have the most power to shape the future?
  - Distrust a lot
  - Distrust somewhat
  - Neither trust nor distrust
  - Trust somewhat
  - Trust a lot
- Do you agree or disagree with the following statement?—I believe people like me have the power to help influence important changes that shape the future.
  - Definitely agree
  - Tend to agree
  - Tend to disagree
  - Definitely disagree
  - Neither agree nor disagree

- Do you agree or disagree with the following statement?—I find it impossible to keep up with the pace of change.
  - Definitely agree
  - Tend to agree
  - Tend to disagree
  - Definitely disagree
  - Neither agree nor disagree
- Do you agree or disagree with the following statement?—I feel I have a good idea of what and who drives change in society
  - Definitely agree
  - Tend to agree
  - Tend to disagree
  - Definitely disagree
  - Neither agree nor disagree
- Do you agree or disagree with the following statement?—I believe there is a technological solution to all of humanity's problems
  - Definitely agree
  - Tend to agree
  - Tend to disagree
  - Definitely disagree
  - Neither agree nor disagree
- I feel like social and technological changes in the near future will make communities…
  - Much less connected
  - Somewhat less connected
  - Neither more nor less connected
  - Somewhat more connected
  - Much more connected
- Overall, I expect the impact on me personally caused by technological and social changes over the next twenty years to be . . .
  - Major and negative
  - Minor and negative
  - Fairly ineffective either way
  - Minor and positive
  - Major and positive
- Do you consider technological progress to be a force for good, bad, or neither?
  - Strongly a force for bad
  - Somewhat a force for bad
  - Neither a force for good nor bad
  - Somewhat a force for good
  - Strongly a force for good

- Which one of the following best describes you?
  - I only replace technology products when they go wrong or are broken
  - I sometimes buy new technology products but only when I really like them
  - I like to get new technology products after they've been out for a while
  - I'm always keen to use new technology products as they enter the market
  - I'm actively on the lookout to buy new technology devices and services

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