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Are Civil Engineers "Practicing What They Preach?"

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Patricia is a water engineer with a background in both the private and public water sector. She has expertise in the design of flood alleviation schemes and wastewater networks. Patricialeads Academic Programme Enhancement and Development for the College of Engineering. With her background in industry, she is keenly aware that the sector-wide academisation and de-contextualisation of engineering education is leading to an engineering sectorthat struggles to relate theory to practice.

Her main area of research is into the social impact of engineers and engineering – critiquing how the methodologies adopted by engineers can sometimes run counter to the needs of communities they serve and reinforce structures of power that maintain inequality. Civil Engineering in particular is inextricably linked up with societal change, and responsible engineering is about understanding wider environmental and social impacts of design and construction. Patricia teaches creative design modules that give students tools and techniques (Human-centered design, VR collaborative design tools) to find their own brand of creativity, while prompting students to consider how their individual privilege and biases impact on their design decisions.

Are Civil Engineers 'Practicing what they Preach'?

Abstract

Studies show that personal values can influence decision making, problem solving, and behaviour. We draw from this literature and analyse the link between personal value and designs produced by civil engineering students, as part of a Human-Centred Designing assignment. We also study the influence of priming on design decisions.

We collected data on Schwartz's Personal Value Systems of first- and third year civil engineering students at a university in Wales. Students were set a conceptual design task to fulfil a variety of human needs from subsistence to freedom, with the intention of elevating the quality of life of residents by meeting as many needs as possible. We analysed which Higher Order Values were more likely to produce designs with community-orientated spaces that enable residents to interact, fulfilling communal needs, termed 'Communal Designs'.

While the majority (63.93%) of first year students were in the Higher Order Value *Self Transcendence* category, which is aligned with communal values, only 27.78% of them produced a Communal Design, with 50% of these having higher-than-average social desirability scores. On the other hand, the majority of Communal Designs (73.33%) were produced by those in the Higher Order Value *Openness to Change* category, with only 18.18% of these having higher-than-average social desirability scores. These findings lead us to either doubt the accuracy of the claimed Higher Order Value of the majority of civil engineering students, or require us to make sense of the dissonance between proclaimed values held, and the lack of acting upon it to produce Communal Designs.

Priming had no significant effect on whether a student produced a Communal Design, although it seemed to have a significant decreasing influence on Empathic Concern, which is associated with prosocial, altruistic, self-transcendent acts. Our study also shows that the majority (54.84%) of third year students, also had their primary Higher Order Value as *Self Transcendence*. Comparative analyses were run to search for differences in personal value systems between the first year and third year civil engineering students. It was found that third year students valued *Tradition* more than first year students. *Tradition* ultimately contributes toward the Higher Order Value of *Conservation*, which is opposed to *Openness to Change*, and thus the likelihood of a student producing a Communal Design.

First year students had a significant correlation between their Basic Value of *Tradition* and their Higher Order Value of *Self Enhancement*, and between *Tradition* and their Higher Order Value of *Openness to Change*. Third year students were found to have a significant correlation between *Tradition* and their Higher Order Value of *Self Transcendence*. This is an interesting finding, given that *Self Enhancement* and *Self Transcendence* are opposing in nature, and that there has been discussion of how cultural values could change within engineering education over time.

We also discuss whether Sheeran & Web's 'Intention - Behaviour Gap' could offer an explanation of the dissonance between the Higher Order Value and the decision to act in accordance with it (for example, a Higher Order Value of *Self Transcendence*, a communal value, was hypothesised to lead to designs promoting community, but this did not occur).

In taking this forward, the principles behind identifying Communal Designs were found to align to 'Placemaking', a term used in architectural urban design to cultivate spaces for community engagement. We propose that Placemaking could be integrated into civil engineering's conceptual design education, as it may provide a framework for civil engineers to consider social impact of design.

Keywords: Civil Engineering Design, Personal Values, Priming, Human-Centred Design, Decision Making, Engineering Values, Intention-Behaviour Gap, Placemaking

Introduction

Engineers are first and foremost human beings – at least for now – with personal belief, norm, and value systems. In this paper, we discuss the possible effect of the engineers' personal values on their behaviour, decision making (which is linked to problem solving [1]), and quality of design produced, especially when working on a Human-Centred Design task.

Schwartz's Personal Value System

According to Schwartz [2, p.3], values are what "we think of what is important to us in life" and that "each of us holds numerous values (e.g., achievement, security, benevolence) with varying degrees of importance."

His value system consists of 19 values which all people hold, but in varying rank or order according to personal relevance, importance and priority. This "tradeoff amongst the relevant values", he says [2, p.12], within the value system of a person, is what classifies which *category* (named *Higher Order Value*) of the human value system this person resides in, and therefore how this person's motivation and decision-making processes are driven. This "tradoff" or categorising process can be achieved using the PVQ-RR 57 questionnaire [2],[3], which will be discussed further in the Methodology.

The link between motivation, decision making, and personal value will also be discussed in the following few paragraphs.

Values	Conceptual definitions in terms of motivational goals
Self-direction –	Freedom to cultivate one's own ideas and abilities
thought	
Self-direction – action	Freedom to determine one's own actions
Stimulation	Excitement, novelty, and change
Hedonism	Pleasure and sensuous gratification
Achievement	Success according to social standards
Power – dominance	Power through exercising control over people
Power – resources	Power through control of material and social resources
Face	Security and power through maintaining one's public image and avoiding humiliation
Security – personal	Safety in one's immediate environment
Security – societal	Safety and stability in the wider society
Tradition	Maintaining and preserving cultural, family, or religious traditions
Conformity – rules	Compliance with rules, laws, and formal obligations

Table 1: The 19 values of the Schwartz value system with their definitions in terms of motivational goal(s) [3, p.7]:

Conformity –	Avoidance of upsetting or harming other people
interpersonal	
Humility	Recognizing one's insignificance in the larger scheme of things
Benevolence –	Being a reliable and trustworthy member of the ingroup
dependability	
Benevolence – caring	Devotion to the welfare of ingroup members
Universalism –	Commitment to equality, justice, and protection for all people
concern	
Universalism – nature	Preservation of the natural environment
Universalism –	Acceptance and understanding of those who are different from oneself
tolerance	

Based on the "tradeoff" of the 19 values [see Table 1], a person is then categorised into *Higher Order Values* [3]. These Higher Order Values are listed in Table 2 below. Calculated PVQ-RR scoring [4] of the different 19 values of Table 1, map onto these four different *Higher Order Values* shown in Table 2.

Table 2: Higher Order Values [3]:

Higher Order Value	Achieved by combining the means of the
	following Values:
Self -Transcendence	Universalism – nature, universalism –
	concern, universalism – tolerance,
	benevolence – care, and benevolence –
	dependability
Self – Enhancement	Achievement, power – dominance and power
	– resources
Openness to Change	Self-direction – thought, self-direction –
	action, stimulation and hedonism
Conservation	Security – personal, security – societal,
	tradition, conformity – rules, conformity –
	interpersonal. Humility and Face may also be
	included in Conservation.

All values and Higher Order Values eventually map onto Schwartz et al.'s Circular motivational continuum [3, p.7], shown in Figure 1.



Figure 1 – Circular Motivational Continuum [3, p.7]

It is important to note that on this system, *Self Transcendence* and *Self Enhancement* are adverse in nature and are thus are mutually exclusive (hence, one cannot be categorised (or ranked highly) in both polarised categories, simultaneously), and so are *Openness to Change* and *Conservation* [3]. This can also be visualised on the Circular Motivational Continuum shown in Figure 1, as *Self Enhancement* and *Self Transcendence* are set across from each other, and so do *Conservation* and *Openness to Change*.

Personal Value System's Link to Belief, Standards and Action

Values are linked to various aspects of human life, for example belief, standards, and action. Schwartz summarises his and others' implicit concepts of values in the following main features listed in Table 3 [2, p.3-4], (citing himself [5],[6], and [7]-[11]).

Table 3: Concepts of Values [2]

(1) **Values are beliefs linked inextricably to affect**. When values are activated, they become infused with feeling. People for whom independence is an important value become aroused if their independence is threatened, despair when they are helpless to protect it, and are happy when they can enjoy it.

(2) Values refer to desirable goals that motivate action. People for whom social order, justice, and helpfulness are important values are motivated to pursue these goals.

(3) **Values transcend specific actions and situations**. Obedience and honesty values, for example, may be relevant in the workplace or school, in business or politics, with friends or strangers. This feature distinguishes values from norms and attitudes that usually refer to specific actions, objects, or situations.

(4) **Values serve as standards or criteria**. Values guide the selection or evaluation of actions, policies, people, and events. People decide what is good or bad, justified or

illegitimate, worth doing or avoiding, based on possible consequences for their cherished values. But the impact of values in everyday decisions is rarely conscious. Values enter awareness when the actions or judgments one is considering have conflicting implications for different values one cherishes.

(5) **Values are ordered by importance relative to one another**. People's values form an ordered system of priorities that characterize them as individuals. Do they attribute more importance to achievement or justice, to novelty or tradition? This hierarchical feature also distinguishes values from norms and attitudes.

(6) **The relative importance of multiple values guides action**. Any attitude or behavior typically has implications for more than one value. For example, attending church might express and promote tradition and conformity values at the expense of hedonism and stimulation values. The tradeoff among relevant, competing values guides attitudes and behaviors [5],[12]. Values influence action when they are relevant in the context (hence likely to be activated) and important to the actor.

Existing literature on Engineers' and Engineering Students' Personal Values

Munson and Posner [13] discussed the importance of understanding engineering 'profiles' back in 1979. They evaluated and understood engineering personal values in the workplace, and further suggested that a better understanding of personal values is "critical to an organisation's effective performance" [13, p.99], as they may hold an impact on organisational decisions, regarding "job placement, promotion, formation of special groups, and in the design of employee motivation and incentive programs" [13, p.94].

Using the Rokeach Value Survey (RVS) [11] to collect engineers' and managing engineers' *instrumental* and *terminal* values – *instrumental* values are those involving "preferable modes of conduct (e.g., ambition, being logical and cheerfulness)", and *terminal* values are those to do with "desirable and states of existence (e.g., an existing life, family security, and social recognition)" [13, p.95]. Their findings show that engineers and engineering managers have significant differences in personal values, and so do "below-average- success" and "above-average success" engineers:

- "In terms of instrumental values, engineering managers attach significantly less importance to the values "cheerful," "independent," and "loving" than do engineers" [13, p.95];
- "Engineering managers attach significantly greater importance to the terminal value of "pleasure" than do engineers and less importance than engineers to "wisdom" [13, p.95];
- "The below-average-success engineers attach significantly greater importance than the above-average-success engineers to "a comfortable life," "world at peace," "true friendship," "cheerful," and "courageous." (*Terminal* values) [13, p.95];
- "The above-average-success engineers attach significantly more importance to "a sense of accomplishment" and "responsibility" than the below-average-success group." (*Instrumental* values) [13, p.95].

Another school of value systems include the *Agency/Communion* value system – otherwise known as the *fundamental dimensions* [14],[15], or the *Big Two* [16]. This dichotomous

framework of personal value (and subsequent motivation) was initially proposed by Bakan in 1966 and was designed to categories people into two sets of "human existence" [17]: the *Agentic* (those preferring "getting ahead" [18]) versus the *Communal* (those preferring "getting along" [18]) [17],[18].

Diekman et al. [19] argued that "STEM careers are perceived as less likely than careers in other fields to fulfil communal goals (e.g., Working with or helping other people)" in their paper, and indeed, found that "STEM careers, relative to other careers, were perceived to impede communal goals" and that "communal-goal endorsement negatively predicted interest in STEM careers, even when controlling for past experience and self-efficacy in science and mathematics".

This concept was further supported by Ramsey [20] when she took on the case study of students and faculty members of a university science department and found that "both faculty and students, regardless of gender, perceived agentic traits as more important for success in science than communal traits".

To 'tie' value systems together, Trapnell and Paulhus [21], conducted a study and found that *agentic* values are more corelated to *Self Enhancing* values, and similarly, *communal* values to those of *Self Transcending* and *Conservation* values, of the Schwartz's Personal Value system. These findings were obtained during their development of the ACV (Agency/Communion Value) Scale. Their exact findings were: "high loadings for achievement, power, hedonism, and stimulation: This factor clearly represents a superordinate agency dimension. The second rotated factor corresponds to a very broad communal dimension, combining vertical collectivist values such as conformity, tradition, and security, with horizontal collectivist values, such as universalism and benevolence. These results parallel the preceding findings for life goals by documenting superordinate A & C dimensions within the Schwartz value taxonomy" [21, p.42].

Mejia, Chen and Chapman [22],[23] took an approach to comprehend engineering students' personal values, in ASEE's 2020 conference proceedings. What they found (after their evaluation of students' discourse of what is considered "important to their [students'] vocation") and discussed in their presentation [23] of their paper [22] the following:

- "Preliminary results indicate that engineering Discourses may influence the conceptualizations of status, power, and solidarity in relationship to their values and vocations" [22];
- "Top values selected by students included: *family, health, purpose, friendship, adventure*, and *growth*" [23];
- "Community and society were included or considered in the students' actionable values in very few cases" [23];

They also stated that "Engineering Discourses may contribute to the students' tendency to simplify or narrow down social aspects of engineering activity" [23], and moreover, argued that "Now, more than ever, as engineering educators we need to explore and analyze how students' core values may clash with engineering Discourses" [23].

Personal Value and Decision Making, Prosocial Behaviour, Ethics and Empathy

Bayram [24] argued that "values are intimately related to prosocial behaviour" [24, p.4]. She defines prosocial behaviour as "actions undertaken to benefit and help others (citing [25], [26])" [24, p.1], and argues that it can be traced back and predicted by basic human values. She finds in her study, that *Self Transcendence* and *Openness to Change* values are indeed reliable predictors of support for "foreign development assistance", or in other words, prosocial behaviour (as she explains it).

Campbell and Wilson [27]– agreeing with Lucena et al.'s [28] concept of humanitarian engineering as "an important dimension of engineering practice that deserves clearer ethical articulation and curriculum development" ([27, p.4], citing [28]) – discuss how humanitarian engineering is accentuated by particularly exercising engineering ethics, and how "care" maps onto humanitarian engineering. They even call it "Humanitarian Engineering as a Matrix of Care and Ethics" [27, p.5].

We think that Human-Centred Designing is indeed a form of Prosocial Behaviour and that it is directly linked to exercising engineering ethics, and so, would therefore like to explicitly address the link(s) between personal values and ethical practice and judgement in the following few paragraphs.

Finegan [29] found that peoples' rank for the *instrumental* value of *honesty* was the best predictor of judgement (about the morality of a behaviour), whilst the *terminal* value of *ambition* was the best predictor of behavioural intentions, in the workplace. The Rokeach Value Survey [11] was used to determine personal values in this study.

Fritzsche & Oz [30] investigated "personal values' influence on the ethical dimension of decision making". They investigated personal values as they relate to five types of ethical dilemmas – namely, "Bribery", "Coercion", "Deception", "Theft", and "Unfair discrimination" – and found "a significant positive contribution of altruistic values to ethical decision making and a significant negative contribution of self-enhancement values to ethical decision making". Values here refer to Stern et al.'s [31] adaptation of the Schwartz's Value System [32]. Altruistic Values here meant "A world at peace; free of war and conflict; social justice; correcting injustice; care for the weak; equality; equal opportunity for all", whilst Self -Enhancement ("or Egoistic") Values here meant "Authority; the right to lead or command; influential; having an impact on people and events; wealth; material possession; money".

As for the aspect of "care" [27] and empathy in Humanitarian designing, a study by Oriol et al. [33] found a "strong relationship between self-transcendent aspirations, gratitude, and cognitive and affective empathy". This study used the *Aspiration Index* [34], to assess *intrinsic* ("personal growth, close relationships, community involvement, and physical healthy") and *extrinsic* ("popularity, financial success, ad image") aspirations. They [33] based their literature on Grouzet et al.'s [35] concept of "self transcendent goals are intrinsic aspirations that are considered prosocial, and they imply connecting with others and going beyond selfish concerns" [33, p. 2] citing [35]. Their results also supported Kasser and Ryans' [34] notion that "Self-transcendent aspirations as community involvement focus people's interest not only on themselves, but also on others" [33, p.7] citing [34].

Mashlah [36] discusses personal values in the workplace and his model schematically illustrates the sequential effect of values on attitudes, behaviour, characteristics, decisionmaking, perceptions, motivation, morals/ethics and spirituality (See Figure 2).



The Role of people's Personal Values Model

Figure 2 – Mashlah's Schema of Value Influence [36]

Human Centred Designing and Empathy and Ethics

Call it human-centred [37] – [41], empathic [42] – [44], compassionate [45], humanitarian [27],[28], or 'socially – just' [46],[47] designing – the value of it remains the same: having the needs of the people at the core of the design and the design process.

This can be achieved via an attempt of *actively* empathising with the people [39], [48], to better understand their needs and requirements [38], [40], to effectively define the problem(s) [47], and thus produce more effective and impactful solutions or designs, with the intention to positively influence the peoples' living standards and quality of life [46],[41].

Empathy can be described in many different forms. Some of its most popular interpretations include [49]:

(A) Feeling what someone else feels;

(B) Caring about someone else;

(C) Being emotionally affected by someone else's emotions and experiences, though not necessarily experiencing the same emotions;

- (D) Imagining oneself in another's situation;
- (E) Imagining being another in that other's situation;
- (F) Making inferences about another's mental states;
- (G) Some combination of the processes described in (A)-(F); [49, p. 2].

As mentioned earlier, [27] argued that in the execution of humanitarian engineering, a "neglected dimension", that is, "care", is "not simply a nice thing for engineers to do in some cases, but, when properly invoked, makes a rich, meaningful, and needed contribution to the engineering education endeavor". "Care" here [27] was defined as "an active, interpersonal compassion, empathy, or concern for the wellbeing of others". This further emphasises the weight of active empathy in such designing processes.

'Design for social justice', as expressed by Leydens et al. [47] is "the design process [that] is explicitly motivated by the goal of equitable distribution of opportunities and resources in order to enhance human capabilities while reducing externally imposed risks and harms" [47, p.6], and that "HCD [human-centred designing] for communities brings students closer still to the social justice dimensions of their design work as it necessarily grapples with the social relationships that define an individual's standing and opportunity structure within a given community context." [47, p.6]. They further elaborated on the link between Human-Centred Designing for communities and social justice with: "while HCD for communities necessarily attends to the social relationships that undergird the lived experiences of community members, social justice is merely another dimension of the equation considered by designers and not the principle motivator or goal." [47, p.6].

Drawing on the above, we particularly emphasise the links between prosocial behaviour, 'socially-just', humanitarian, and human-centred designing.

Walther et al. [50] discuss the demand for and the role of empathy in the engineering practice, and its implicit ties to the social work facet of engineering. They [50] proposed a model for empathy as a learnable and a teachable skill in their paper "a model of empathy in engineering as a teachable and learnable skill, a practice orientation, and a professional way of being". The 'professional way of being' part being tied to the engineers' execution of engineering ethics and moral judgement, and to the implicit bonds of engineering practice to improving society. They also discuss accompanying methods which they think should also be taught and integrated for the engineers/engineering students to be able to "switch between [their] empathic and analytic modes" [50, p.134].

Moreover, Zickfel et al. [51] make a more detailed connection, and talk about the role of *empathic concern* as a part of a 'general communal emotion'; and Decety and Yoder [52] found that empathy is "an obvious candidate in playing a critical role in justice motivation" [52, p.8] and that "individual differences in cognitive empathy and empathetic concern predicted sensitivity to justice for others, as well as endorsement of moral rules" – which in essence, what is ought to be accessed, in order to via produce 'socially-just', 'communal', human-centred, humanitarian design(s). Further, "a large body of research has demonstrated that empathic concern is associated with prosocial behavior in both children [53],[54], and adults [55],[56]" [52, p.9].

Walther et al. [50], citing [57], stated that "Developing a whole professional persona anchored in, and simultaneously supporting, the development of other facets of empathy would also afford students with tangible opportunities to integrate personal values and beliefs with professional goals and actions" – which links us back to the major course of this paper that is: understanding civil engineering students' personal values and their implications on human-centred designing, and in their production of what we later term 'Communal Designs'.

Priming, Decision Making, Empathy and Human-Centred Designing

Priming, or the priming effect, occurs when people's behaviour [58],[59], perceptions [60], performance on cognitive tasks [61], and /or attitudes and values [62], are unconsciously prompted, due to their exposure to subtle contextual cues (called primes) that are semantically related to and/or aligned with an intended concept or change.

Priming has been proven to affect decision making [63], ethical decision making [64], and moral judgement [65], [66]. It has also been proven to induce emotions (happiness and anger) [67], and induce empathy [68]– in a prosocial behaviour related context [69], and in a 'feel others' pain' context [70], [71]. It has also shown to influence *empathic responding* [72] and empathy related to personal value [73].

The idea of priming was initiated based upon the fact that most of human behaviour (and thus its associate – decision making, based on other literature) is rather 'nonconscious' in nature [74], [75], making an unconscious, *automatic* trigger towards a targeted behaviour change, viable [76], [77].

Primes can be in any form of sensory cues that can trigger a certain semantic schema in a person's mind (or a set of memories) when this person is exposed to them. Primes can be olfactory [78], auditory [79], and/or visual [80]. *Supraliminal* visual priming (happening above consciousness detection threshold), as opposed to *subliminal* visual priming (happening below consciousness detection threshold), is considered to be longer lasting in effect [81], and have a more pronounced contact with the parieto-frontal area of the brain [82]. Rizzolattin & Sinigaglia [83] state that there are "several mechanisms" to understand the behaviour of others, however, "the parieto-frontal mechanism is the only one that allows an individual to understand the action of others 'from the inside' and gives the observer a first-person grasp of the motor goals and intentions of other individuals". This appears to be quite (literally) resonating with empathy and its definition addressed earlier by [49].

Based on our understanding of the literature provided on priming, we explain priming interventions as the following: when found in a situation requiring a fast response regarding Topic A, whilst simultaneously being unconsciously 'semantically available' in the Topic B schema (due to the exposure of the priming cues), then a person would ought to automatically, unconsciously, and passively produce an instantaneous, fast solution for Topic A based on the semantic information, experiences, and 'mindset' associated with Topic B as well (see [84] – [86], [58] for more information).

Priming has been a known persuasive technique used widely in Politics [87], Marketing and Advertising [88], and in the educational process of autistic children [89], as it is also proven to surpass 'disruptive transition behaviour' [90].

There has been many studies were visual priming affected behaviour and decision making:

- A study by Latu et al., [91] showed that female participants who were primed with pictures of powerful women ('role models') demonstrated better speech delivery and leadership skills.
- A study by Fitzsimons et al. [92] shows that behavioural traits such as 'creativity' was triggered when participants were exposed to priming imagery logos of Apple; and 'honesty' when exposed to Disney logos.

• And finally, the famous experiment by James Vicary in 1957 showed that people consumed more popcorn and drank more Coca Cola when they were visually primed to do so, whilst watching a movie in a theatre hall. Although some accused this to be a hoax, Karremans et al., [93] conducted a similar study, and found aligning results.

We propose that priming civil engineering students during a Human-Centred Designing Assignment, could hold the potential of producing more 'communal' designs by inducing empathy towards the people they are designing for. This can also facilitate their imagination and understanding of the peoples' situations and needs, and further reminds them of the impact of their designs, and their responsibility as engineers, to produce designs and solutions intended to elevated people's quality of life. This, as the previous literature already explained, is facilitated by properly understanding and defining these peoples' needs, and putting those at the core of design processes. We also argue that priming can act as a 'human-centred value reinforcer', as targeted behaviours via priming has shown to have increased over time [89]. Another reason for our use of priming was to induce subtle change (as opposed to sudden, obligatory change) to bypass possible resistance coming from students when suddenly *forced* (as one would in a typical top-down teaching dynamic) to engage with relatively foreign nontechnical, public welfare related work/design – see [94] for a review on the use of priming in engineering Human-Centred Designing.

Primes used in this paper were visual – supraliminal pictorial cues were used to intentionally trigger certain schemas and internal responses (- specifically, empathy and 'understanding') in the students, during their Human-Centred Designing Assignment. The reason behind choosing supraliminal pictorial primes was because it was the most convenient form of sensory priming to be set in an online assignment, and is longer lasting in effect [81].

Research Questions

We took the case study of civil engineering students at a university in Wales, and proceeded to test for the following research questions:

- 1. <u>What personal *Higher Order Value* category do most first year civil engineering</u> <u>students reside in (*Self Transcendence, Self Enhancement, Openness to Change*, or <u>*Conservation*)?</u></u>
- 2. Do those who state their personal values to be rooted in *Self Transcendence* give more consideration to 'communal' design solutions in their Human-Centred Design <u>Assignment?</u>
- 3. <u>What is the effect of visual priming on students' consideration and integration of the</u> <u>Communal Designs?</u>
- 4. <u>How does Social Desirability (SD) associate with Communal Design production, of either category of the Higher Order Values?</u>
- 5. What is effect of the priming on the Empathic Concern of the Empathy IRI scale?
- 6. <u>What personal *Higher Order Value* category do most third year civil engineering students reside in (*Self Transcendence, Self Enhancement, Openness to Change*, or <u>*Conservation*)?</u></u>

7. <u>How does the value system of third year civil engineering students differ from that of first year civil engineering students?</u>

Communal Design is defined in this paper as a design that considers the provision of a place (or at least a route) for people to get together, enhancing their interactions and communal links. Communal Designs in this study were characterised by the inclusion/consideration of selected interaction-orientated human needs from Max-Neef's Matrix of Human Needs and Satisfiers [95, p.32-33] [See Table 4]. We qualitatively determined whether the designs provided by the students addressed these criteria (declaring it a Communal Design) or not. If a design considered and addressed peoples' needs, but was not specifically inclusive of the selected communal, interaction needs in Table 4, then while the design might be considered to meet some human needs (a form of Human-Centred Design), it does not meet the requirements of Communal Design. Communal Designs are thus inclusive of both metaphysical human needs as well as their physical ones (which by inevitable practice, civil engineers ought to think of these first).

Table 4: Criteria for Communal Design, Extracted from Matrix of Human Needs and Satisfiers [95]

Needs according to axiological	Needs according to the existential category:
categories:	"Interacting"
"Protection"	Box 8: "Living Spaces, social environment,
	dwelling".
"Participation"	Box 20: "Settings of participative interaction,
	parties, associations, churches, communities,
	neighbourhoods, family".
"Idleness"	Box 24: "Privacy, intimacy, spaces of closeness,
	free time, surroundings, landscapes".

Methodology

The basis of following methodology has been adopted (and slightly modified to accommodate Covid-19 implications on lecturing format) from our previous study [94] – see [94] for a review.

Human-Centred Designing, Max-Neef's Matrix of Basic Human Needs, and Priming

Campbell and Wilson [27] proposed that "When one has:

1) a specific location or people in mind;

2) involved those people in the design and decision-making process; and

3) together reached a consensus on solutions that are in the people's best interest; one is much closer to the economic, environmental, global and societal issues and one can better understand their importance" [27, p. 4].

Aligning with the above framework, we proposed the following take on Human-Centred Designing Assignment (see also [94]):

Our case study involved the structural development and improvement of the residents' quality of life of one of two adjacent, yet very contrasting in structural development, districts in Beirut, Lebanon – Hamra and Shatila. The two districts are only 4.1 miles apart, yet Hamra is a prosperous area with adequate infrastructure, and Shatila is refugee camp, initially designed to accommodate 3000 people, but is now accommodating 40000 [96].

As the designers (civil engineering students) could not have accessed both areas to collect data first hand on the residents' quality of life and human needs, nor could they interact with the people (of either area), we provided reports on the 'quality of life' of the residents of both districts (with numerical data indicating the number of the healthy versus the ill, the number of the educated versus the uneducated and the number of the employed versus the unemployed, for example).

We also provided them with a Matrix of Basic Human Needs, designed by Max-Neef [95]. The matrix incorporates and lists all basic human needs that typically have to be met in order to live a satisfactory life.

Maps and plans of either district (along with residential listings and form of occupation – domestic or business) were also given to the students. This was to give them an insight on the 'urbanisation' of either district and of the road networks, to facilitate the designers' understanding of the environmental and cultural scenario/status they are to 'deal with'.

This Human-Centred Designing Task composed of two sections: The first was for the students to compare the structural development of either district, and reflect and make the connection of how many of the human needs (of the Matrix of Human Needs of Satisfiers) are already considered in each plan, and therefore see how that is reflected in the quality-of-life reports of the residents of either district.

The second section was to design a Human-Centred Design *for* the people of Shatila, with the purpose and intention of positively impacting their quality of life in both the short and long run. They were encouraged to include as many of the human needs (of the Matrix of Basic Human Needs and Satisfiers) that the people of Shatila ought to have currently missing. The students were also encouraged to look for the 'root' of the problems and solve for that instead of providing 'plaster'/temporary solutions for Shatila's current situation. 'Creative solutions' were also encouraged by prompting students to try to solve multiple issues per solution or design. They were continuously encouraged to 'put themselves in the shoes' of those living in Shatila that they are designing for, in attempt to help them understand what the 'true' problems are and what they, as people, would need, to produce more effective (and empathic) human-centred designs.

We used supraliminal, visual, priming in Human-Centred Designing (see also [94]), in attempt to help the students visualise, understand, and empathise with those they are instructed to design for – the people of Shatila. The primed cohort was primed with pictures of residents of Shatila, carrying day to day activities, clearly presenting the less fortunate living standards these people are living in. They were pictures of children playing in unfit places like dumpsters, and people walking down a street with waste lying on either sides, and improper electrical cables instalment, dangling just above their heads. They were meant to show the unsafe, unhealthy status of living, and to thus induce empathy (cognitively – in

further understanding their mode of living and needs, and emotionally – in further aiding the compassionate designing) in the students exposed to them.

Only half of the cohort were primed during the Human-Centred Designing Assignment, the other half acted as our control group. Note that none of the students were primed during the Personal Value data collection (Phase I of the study – See Figure 3). The cohort was split quasi-randomly, in attempt to keep the male:female and home student:international student ratios equal in both groups (Primed versus Nonprimed/Control groups), during the Human-Centred Designing (Phase II) of the study [See Figure 3].

Directly after their section on providing a solution/design for the people of Shatila, all students of both Primed and Non-primed groups, were asked to fill in two questionnaires on empathy (IRI) [97] and Social Desirability (MCSDS) [98].

Participants

Our case study involved first year and third year civil engineering students at a university in Wales.

61 first year civil engineering students were involved in this study (11.48% of them were female, and 14.75% were international students).

31 third year civil engineering students were also involved in this study (29.03% of them were female, and 38.71% were international students).

Procedure

Prior to the Human-Centred Designing task, all students were requested to fill PVQ-RR [3] questionnaires to collect data of Personal Values – this was Phase I of the study [see Figure 3]. A month later, the Human-Centred Designing Assignments was set – this was Phase II of the study [see Figure 3]. The assignment was set for two weeks, in which students had to work on the comparative analyses and solution design for the people of Shatila, and fill in the IRI [97] and MCSDS [98] questionnaires that followed.



Figure 3 – Data Collection / Study Overview

Personal Value Questionnaire - PVQ-RR 57

The PVQ-RR [3] is a 57- item questionnaire which measures the "tradeoff" between the 19 Values [2] mentioned earlier (see Introduction). Each item on the questionnaire describes a person with particular interests, importance(s), and values; for example, "It is important to him to plan his activities independently" and "It is to her to be very successful". For each item, respondents are requested to rate how much the person described is like them (note that the PVQ-RR proposes identical questions, but with different gender-matched pronouns, for males and females separately). Responses range from *Not like me at all* (1) to *Very much like me* (6) for each item.

Interpersonal Reactivity Index on Empathy - IRI

The IRI scale [97] measures four different facets to empathy – *Empathic Concern* ('otheroriented' empathy), *Personal Distress* ('self-oriented' empathy), *Perspective Taking*, and *Fantasy*.

Definitions for each of these subscales are directly quoted from [97]:

- Perspective Taking the tendency to spontaneously adopt the psychological point of view of others;
- Fantasy taps respondents' tendencies to transpose themselves imaginatively into the feelings and actions of fictitious characters in books, movies, and plays;
- Empathic Concern assesses "other-oriented" feelings of sympathy and concern for unfortunate others;
- Personal Distress measures "self-oriented" feelings of personal anxiety and unease in tense interpersonal settings;

The IRI scale consists of 28 items, that eventually map onto the four subscales of empathy mentioned above. Each item response ranges from *Does not describe me well* (0) to

Describes me very well (4). An example of these items is "I try to look at everybody's side of a disagreement before I make a decision" (- a *Perspective Taking* item). The IRI scale consists of reversely coded items as well; an example of such items is "Sometimes I don't feel very sorry for other people when they are having problems" (- an *Empathic Concern* item, and is reversely scored).

Marlowe - Crowne Social Desirability Scale - MCSDS

The Marlowe – Crowne Social Desirability Scale [98] is a scale designed to measure how socially desirable (or complying to a more socially preferable) the responses provided by a responder are. Results from this scale can be correlated with other responses of this particular responder, which can then give an indication of how (and to what grade) other responses from this responder are complying to a socially desirable answer. In other words, it can imply of how 'true' the responses of this responder are.

This scale consists of 13 items, and for each item, a responder has to select whether it *truly* or *falsely* applies to them. The higher the cumulative score, the higher the social desirability is considered the responses are.

Examples of such items include "I'm always willing to admit it when I make a mistake" and "I have never deliberately said something that hurt someone's feelings".

It is important to note that in this study, those who ranked 'high' on the Social Desirability score, were those with higher than the average Social Desirability score of the whole first-year group cohort; and similarly, those ranked 'low' on the Social Desirability, has a response score lower than the first-year cohort's average Social Desirability score.

Results

The results are displayed in response to the research questions' order.

RQ 1. <u>What personal *Higher Order Value* category do most first year civil engineering students reside in (*Self Transcendence, Self Enhancement, Openness to Change*, or <u>Conservation)?</u></u>

Table 5: Breakdown of the number of first – year students in each of the four Higher Order Value categories:

Highest Ranking Higher Order Value	Number of Students (N)	Percentage (%)
Conservation	3	4.92
Self Enhancement	2	3.28
Openness to Change	17	27.87
Self Transcendence	39	63.93
Total	61	100

The breakdown of the number of first – year students in each of the four Higher Order Value categories can be seen in Table 5. The majority of first year students seem to have the highest Higher Order Value to be *Self Transcendence*.

Due to the notion implied by [24] that *Openness to Change* and *Self Transcendence* are more likely to relate to prosocial, 'communal', and thus by extension, human-centred acts/designing, we will only be considering those who categorised highest on the Higher Order Values of *Self Transcendence* and *Openness to Change* in the analyses of results, and the subsequent discussion.

RQ 2. Do those who state their personal values to be rooted in *Self Transcendence* give more consideration to 'communal' design solutions in their Human-Centred Design Assignment?

Table 6: Number of students who produced Communal Designs (out of the total number of designs produced), per Higher Order Value category:

Highest Ranking	Communal Designs	Total No. of	Percentage (%) of
Higher Order Value	Produced per	Designs Produced	Communal Designs
	Higher Order Value	per Higher Order	Produced per Higher
		Value	Order Value
Openness to Change	11	Value 15	Order Value 73.33

A chi-square test of independence was performed to examine the relation between Higher Order Value categories and the production of Communal Designs. The relation between these variables was significant, X^2 (1, N = 51) = 9.07206, p = .002595. Students ranking *Openness to Change* highest, were more likely than *Self Transcendence* to produce Communal Designs [see Table 6].

RQ 3. <u>What is the effect of visual priming on students' consideration and integration of the</u> <u>Communal Designs?</u>

Table 7: Number of students who were primed (of those who produced Communal Designs) per Higher Order Value category:

Highest Ranking	No. of Primed	Total No. Students	Percentage (%) of Primed
Higher Order	Students who	who produced	Students who produced
Value	produced	Communal	Communal Designs, per
	Communal Designs,	Designs, per	Higher Order Value
	per Higher Order	Higher Order	Category
	Value Category	Value Category	
Openness to Change	5	11	45.45
Self Transcendence	6	10	60

A chi-square test of independence was performed to examine the relation between Higher Order Value categories and the number of students who were primed (versus those who were not primed), who produced Communal Designs. The relation between these variables was not significant, $X^2 (1, N = 21) = 0.4443$, p = .5051. A chi-square test of independence showed that there was no significant association between Priming and the number of Communal Design production, of either *Higher Order Value* category [see Table 7].

RQ 4. <u>How does Social Desirability (SD) associate with Communal Design production, of either category of the Higher Order Values?</u>

Table 8: Breakdown of No. of students with higher-than-average social desirability scores (of those who produced Communal Designs) per Higher Order Value category:

Highest Ranking Higher Order Value	No. of Students with High SD, who produced Communal Designs, per Higher Order Value Category	Total No. Students who produced Communal Designs, per Higher Order Value Category	Percentage (%) of Students with High SD, who produced Communal Designs, per Higher Order Value Category
Openness to Change	2	11	18.18
Self Transcendence	5	10	50

A chi-square test of independence was performed to examine the relation between Higher Order Value categories and the number of students who had 'high' Social Desirability responses (versus those who had 'low' Social Desirability scores), who produced Communal Designs. The relation between these variables was not significant, X^2 (1, N = 21) = 2.38636, p = .1224. A chi-square test of independence showed that there was no significant association between Social Desirability Scores and the number of Communal Design production, of either *Higher Order Value* category [see Table 8].

This, however, can be argued that if the student sample was slightly larger (1.5 times), then it ought to have a tendency to be significant, as there is a visibly clear dissonance between the 18.18% of the Openness to Change, and the 50% of the Self Transcendence. This can also be seen in Table 9 below, displaying numbers that test for independence of the Higher Order Value categories and Social Desirability, of the whole group (not just those who produced Communal Designs as seen in Table 8).

Table 9: Breakdown of No. of Students with higher – than – average Social Desirability Score (regardless of their production of Communal Design), per Higher Order Value category:

Highest Ranking Higher Order Value	No. of Students with High SD response (of all first-year cohort)	Total No. of SD responses (of all first-year cohort)	Percentage (%) of Students with High SD response (of all first -year cohort)
Openness to Change	5	15	33.33
Self Transcendence	21	34	61.76

A chi-square test of independence was performed to examine the relation between Higher Order Value categories and the number of students who had 'high' Social Desirability responses versus the rest of the cohort with 'low' Social desirability scores. The relation between these variables tends to be significant, $X^2 (1, N = 49) = 3.37801$, p = .06607. A chi-square test of independence showed that there was a tend-to-be significant association between Social Desirability Scores and the Higher Order Value categories [see Table 9], with

those residing in the Higher Order Value category *Self Transcendence* tending to have higher Social Desirability scores compared to those of the *Openness to Change* category.

RQ 5. What is effect of the priming on the Empathic Concern of the Empathy IRI scale?

A two tailed t-test was ran to view the possible effect of priming on the IRI Scale. The results show that the priming only had a significant effect on 1 item of the scale: Item 4 ("Sometimes I don't feel very sorry for other people when they are having problems").

Item 4 represents Empathic Concern and is reversely scored, thus, the higher the response score, the lower Empathic Concern it represents. Table 10 presents the mean scores, and standard deviations, across the Primed and Non-primed cohorts, for that item.

Table 10: Means and the standard deviations for IRI item 4, across the Primed versus the Non-Primed group:

IRI Item	Primed	Non-Primed
	Mean (Standard Deviation)	Mean (Standard Deviation)
Item 4 "Sometimes I don't feel	1.5952 (0.9892)	1.0909 (0.9356)
very sorry for other people		
when they are having		
problems" (p value = $.017397$)		

RQ 6. <u>What personal *Higher Order Value* category do most third year civil engineering students reside in (*Self Transcendence, Self Enhancement, Openness to Change*, or <u>Conservation)?</u></u>

Table 11: Breakdown of the number of third – year students in each of the four High Order Value categories:

Highest Ranking Higher	Number of Students (N)	Percentage (%)
Order Value		
Conservation	5	16.13
Self Enhancement	1	3.22
Openness to Change	8	25.81
Self-Transcendence	17	54.84
Total	31	100

The majority of third year students of Civil Engineering ranked the Higher Order Value of *Self Transcendence* the highest. This can be seen in Table 11.

RQ 7. <u>How does the value system of third year civil engineering students differ from that of first year civil engineering students?</u>

Just as the first year students, the majority of third year students of Civil Engineering ranked the Higher Order Value of *Self Transcendence* to be the highest. This can be seen in Table 12.

Highest Ranking Higher	Year 1 Civil Engineering	Year 3 Civil Engineering
Order Value	Students (%)	Students (%)
Conservation	3 (4.92 %)	5 (16.13 %)
Self Enhancement	2 (3.28 %)	1 (3.23 %)
Openness to Change	17 (27.87 %)	8 (25.81 %)
Self Transcendence	39 (63.93 %)	17 (54.84 %)
Total number of students	61 (100%)	31 (100%)
per year group (%)		

Table 12: The breakdown of number of students per High Order Value category in either year group:

A chi-square test of independence was performed to examine the relation between Higher Order Value categories of both First Year and Third Year Students of Civil Engineering in a university in Wales. The relation between these variables was not significant, X^2 (3, N = 92) = 3.28263, p = .3501. A chi-square test of independence showed that there was no significant association between Higher Order Value categories and the different Civil Engineering year groups [see Table 12].

A two tailed t-test was run to view the differences of each *Value* (basic and Higher Order) on the PVQ-RR Scale across the two year groups. A significant difference in mean was found for the value of *Tradition*, as well as tend-to-be-significant differences for the values of *Conservation (minus the Humility and Face)*, and *Security – Societal*, across the two year groups. This can be seen in Table 13. The mean figures displayed in Table 13 are centralised around zero – the larger and higher the figure is above zero, the higher the ranking of this Value. P values that are underlined are indicated to a have a tendency to be significant, and thus further hinting that they may have been significant had the data set been larger. Standard deviations are presented in brackets next to the mean values in Table 13.

Year Group\ Value	Tradition	Conservation	Security - Societal
		(minus the Humility	
		and Face value)	
Year 1	-1.0154 (1.171)	-1.3529 (3.392)	-0.0454 (1.141)
mean (standard			
deviation)			
Year 3	-0.3113 (1.434)	0.3577 (4.300)	0.3662 (0.952)
mean (standard			
deviation)			
p Value	.02198	.05929	.07145

Table 13: Means, standard deviations, and p values for each Value of either year group:

Table 13 contents can be better visualised on a line graph (see Figure 4). Figure 4 displays the clear difference in (non-overlapping) mean ranks for the three values discussed in Table 13, across the two year groups. It is also clear that the third year group values for *Security* – *Societal*, *Tradition*, and *Conservation* (*minus the Humility and Face*) have means higher than those for the first year group.



Figure 4 – Line Graph representing the difference in mean ranks of Table 13

Pearson correlation tests were also ran to see what the value *Tradition* signifies, by checking what it correlates to, within each year group separately. See Table 14 for results.

Table 14: Size of the correlation between the value of Tradition and other values within each year group:

Higher Order Values Correlated to <i>Tradition</i>	Basic Values Correlated to <i>Tradition</i>	Year 1	Year 3
Conservation		0.388**	0.610**
	Conservation (minus Humility and Face)	0.481**	0.658**
	Humility	No Correlation	0.382*
	Humility and Face	No Correlation	0.382*
	Security – Societal	0.269*	0.739**
Self Enhancement		0.334**	No Correlation
	Power – Dominance	0.336**	No Correlation
	Power – Resources	0.266*	No Correlation
	Achievement	No Correlation	0.396*
Openness to Change		0.268*	No Correlation
	Self Direction – Action	0.332**	No Correlation
	Stimulation	0.312*	0.479**
Self Transcendence		No Correlation	0.455*
	Benevolence – Care	0.287*	0.431*

Benevolence Dependabil	e – No Correlation	0.494**
Universalist Concern	n – No Correlation	0.385*

^{*}p < .05 and **p < .01

Direct Quotes from Communal Designs Received from First Year Students:

- "To begin with, residents and engineers can work to develop public spaces, such as schools, shops, temples and outdoor spaces, allowing for growth within the community. This method is both sustainable and economically viable..." (Student 6, Openness to Change)
- *"Organize social recreational area to improve both social spacing and living environment of the area..."* (Student 72, Conservation)
- "Communal areas such as parks could be built to increase the communal spirit.." (Student 109, *Self Transcendence*)
- "I propose that a library should be built close to the centre of Shatila so that it can be used as a social area for learning and used to expand the spaces for class teaching in the week...This addition will add to the Max-Neef number 8 by providing a social environment for people to meet. It also acts as a place of togetherness and can provide the community to learn skills in which they can be employed by..." (Student 93, Openness to Change)
- "I propose a community centre which provides aid and care for women within the camp who feel vulnerable or isolated...The community centre I am proposing will offer a sanctuary for women, allowing isolated and vulnerable women to feel part of a community in a safe space. The building will provide room for social activities to enable friendships to form but will also include wash facilities and baby changing stations to provide privacy and encourage the idea of selfcare and self-worth" (Student 51, did not complete PVQ-RR)

Discussion

Although the majority (63.93%) [see Table 5] of first year students claimed to have their highest ranked *Higher Order Value* to be *Self Transcendence*, only 27.78% [see Table 6] of them produced a Communal Design. A smaller proportion of the students had their highest ranked *Higher Order Value* as *Openness to Change* (27.87%) [see Table 5], however 73.33% [see Table 6] of these produced Communal Designs that sought to meet social needs of the residents. Communal Design Criteria can be viewed in Table 4.

The results indicated that the priming did not have a significant effect on the production of Communal Design (X^2 (1, N = 21) = 0.4443, p = .5051), see Table 7. A possible reason may have been the fact that it was a two-week online assignment (due to Covid-19), as opposed to the planned four-hour in-class intervention (see [94] for a review). This would have inhibited the priming since it would not have been subtle enough to work. The online version had the priming pictures scattered on their screeen (on their assignment word document) which may have allowed time to cognitively analyse the priming pictures and their effect. Moreover, as students were allowed to log out and into the assignment multiple times over the course of the designated two weeks, the duration and intensity of the priming could not have been

controlled, and its influence on 'fast and instantaneous' responding for the Human-Centred solution making was thus interrupted.

Priming, however, did have an effect on one of the items of the IRI questionnaire – one that was most relevant to the topic, Item 4: "Sometimes I don't feel very sorry for other people when they are having problems", representing *Empathic Concern* [see Table 10]. A two tailed t-test revealed that the priming significantly (p = .0174) decreased empathic concern. This is interesting as a decrease in empathy is odd to the nature of those who value *Self Transcendence*, according to the literature addressed earlier (see Introduction) on the positive association between empathy, empathic concern and self-transcending motives and aspirations. This supports the findings of our other paper [94]. [94] discusses how priming may have 'unveiled' personal values of third year civil engineering students in a similar design task with a different setting, an in-class intervention. Since the priming (in [94]) decreased, rather than increased, social consciousness, which when corresponded to priming empathy, indicated that the students' values were rooted in *Self-Enhancement* [94]. This is in contrast to data in the present paper, as the majority of students chose responses that indicated they had a Higher Order Value of *Self-Transcendence*.

In the present study, the significant decrease in an Empathic Concern item [shown in Table 10] further supports the title of this paper as "Are Civil Engineers 'Practicing what they Preach'?", since this (and the findings of [94]) makes us doubt even more what their *true* personal values are. Moreover, out of the 27.78% of those who produced Communal Designs in the *Self Transcendence* group [see Table 6], 50% of them had higher-than-average social desirability scores [see Table 8]. In contrast, of the 73.33% of students who produced Communal Designs in the *Openness to Change* group [see Table 6], only 18.18% had higher-than-average social desirability scores [see Table 8].

Albeit that the proportions in Table 8 were not shown to be significant $(X^2 (1, N = 21) = 2.38636, p = .1224.)$, it can be argued that they tend to be significant. This is supported by Table 9, which shows the percentage of students with higher-than-average Social Desirability scores in the *Self-Transcendence* versus the *Openness to Change* groups. The proportions of higher-than-average Social Desirability scores for all students across the two *Higher Order Value* categories, have a tendency to be significant (p=.06607) [see Table 9]. With 18.18% of the *Openness to Change* group producing Communal Designs, as opposed to the 50% of the *Self Transcendence* group producing Communal Designs, are with higher-than-average Social Desirability scores [see Table 8], it indicates that those who value *Openness to Change*, are intrinsically driven to produce Communal Designs.

Another possible explanation to this dissonance between the *Self Transcendence* group (which is communal in value, according to [21]), and their corresponding proportions of Communal Design production, could be explained by the Intention-Behaviour Gap [99]. Sheeran and Webb indicate that most people do not refrain from acting upon something because they have no value for it, but rather because they may lack the adequate methodological competencies to do so.

In understanding the intention-behaviour gap between a student's personal values and design decisions, it is relevant to consider the discussion on how the depoliticized nature of engineering education culture may undermine students' ability and interest to engage with humanitarian and communal related engineering [100].

We compared the personal value systems of third year versus first year students, and found that the majority of both year groups had their Highest *Higher Order Value* to be *Self Transcendence*. A two tailed t-test on personal value responses of the students of either year group found one Value to have a significant difference across the two year group cohorts – *Tradition* (p = .02198) [see Table 13]. *Tradition* had a significantly higher mean in the third-year group, compared to the first-year group, indicating that the value of *Tradition* (and by extension, *Conservation* Higher Order Value) increases over the years in Civil Engineering Education. This is particularly important as *Conservation* sits directly opposite to *Openness to Change* [see Figure 1 – Schwartz et al.'s Circular motivational continuum], meaning that if the Higher Order Value of *Conservation* increases, then the Higher Order Value of *Openness to Change* ought to decrease. This is a concern, since the students who were more likely to produce Communal Designs were in the *Openness to Change* category, which appears at risk since the opposing value of *Tradition* is increasing.

The shifts in the students residing in *Openness to Change* versus *Conservation* over time also resonates with the ongoing discussion on how the depoliticized culture of engineering education may undermine students' ability and interest to engage with humanitarian and communal related engineering [100], [101]. Cech showed that over the course of studies, there was a decrease in students' public welfare concerns (the "importance to students of professional/ethical responsibilities, understanding the consequences of technology, understanding how people use machines, and social consciousness") [101]. While Cech's study looked at attitudes, the present study looks at personal value systems, and it is of interest to understand the interrelation between the two.

We ran Pearson (two-tailed) correlation tests on each year group separately to see what the value *Tradition* signifies, by determining which other values it correlates to [see Table 14]. It was surprising that within in the third-year group, Tradition correlated significantly with Communal related Values (see Table 14), whilst in the first year group, Tradition correlated significantly with more Agentic related Values (see Table 14). An example of this includes third year students having a significant correlation between Tradition and Self Transcendence, whilst first year students instead have a significant correlation between Tradition and Self Enhancement as well as Tradition and Openness to Change. Schwartz et al. [3], categorised Self Enhancement and Openness to Change Higher Order Values as 'personal focused', and Self Transcendence and Conservation as 'social focused' [see Figure 1]. Further, [21] indicated that the value of *Tradition* "corresponds to a very broad communal dimension". This led us to question whether engineers 'consider themselves to be more communal' as their value for Tradition increase over time? Third year students also showed a higher correlation to Conservation (r=.610, p<.01) compared to that of first year students (r=.388, p<.01) [see Table 14]. This further emphasizes the increasing emphasis on Conservation over time, which raises the risk of a decreasing emphasis on Openness to Change. This was further reflected in Table 14, that shows first year students correlated Tradition with the Higher Order Value Openness to Change (r=.268, p<.05), whilst third year students showed no significant correlation between Tradition and the Higher Order Value Openness to Change.

Finally, an aligning definition to our Communal Design exists in the concept of 'Placemaking' [102]. Placemaking is a form of architectural urban design, that encourages communal interaction. We propose that Placemaking would be a useful concept to integrate

into design modules, since it overlaps between design and social science, addressing human behaviour and interaction with structures and spaces. Placemaking could be useful as a way of bringing students' attention to social interaction needs, by aiding the understanding of social interactions, and thus bringing in more human-centred, humanitarian values into design, and considering both the metaphysical as well as the physical needs of the people, engineers are to design for.

Conclusions

Studies show that personal values can influence decision making, problem solving, and behaviour. We show in this study that there appears to be a link between Schwartz's Higher Order Value categories and how likely a student is to produce a design that meets metaphysical, social, and interaction needs (termed a Communal Design). Our results show that Civil Engineering students with their highest-ranking Higher Order Value as *Openness to* Change are more likely to produce a Communal Design. We also show how these personal value systems may transform over time in engineering education. During the course of their degree, students seem to have increasing value for *Tradition*, and by extension the Higher Order Value of Conservation. Since the Higher Order Value of Openness to Change is in opposition to Conservation, it follows that an increase in Conservation may risk the students' likelihood to produce a Communal Design. This could offer a possible lens to further understand the findings of Cech [101], who showed a decreasing concern for Public Welfare and Social Consciousness amongst engineering students over time. Further work is recommended to understand how changes in the value of Tradition manifest in practice throughout engineering education over time, and how this is impacting the decision-making and problem-solving strategies of students. We also found that despite the insignificant effect the priming had on Communal Design production, the priming showed a significantly decreasing effect on an IRI item representing Empathic Concern. This was interesting as a decrease in empathic concern is opposite to the nature of those who highly value Self Transcendence – of which we found the majority of civil engineering students self-reported to be categorised as (using the PVQ-RR). This, along with other findings from [94], lead us to skepticize if indeed Civil Engineers have values rooted in Self Transcendence - hence, the title of this paper. Lastly, the integration of an aligning concept to our Communal Design framework, 'Placemaking', and its beneficial outcomes in engineering education and designing was discussed.

Limitations

Due to the Covid –19 implications, and the restriction of face-to-face lecturing, the initially planned four-hour in-class priming intervention was then set to become an online, two-week assessment. This, we think, have had a major impact on the priming's effectivity. Moreover, the Human-Centred Design Assignment set up for the third year students (similar to that held for the first year student) was cancelled, limiting our extension of the study on how personal values could associate with Communal Designs across the two year groups. This work is intended to be completed in academic year 2021/22.

The sample size of this study was relatively small, so for future work, we recommend repeating it for a larger data set, to be able to draw stronger observations and recommendations. Human-Centred Designing should involve the users of the design, but this is impractical in many engineering classrooms, and this was not achievable in this study. A limitation in this study is that students did not have access to the people of Shatila, but attempts were made to give them information that would help them understand relevant issues of living in the camp, and peoples' needs.

It is also worth noting that this study took place in a single university, and as personal values may vary across different cultures and backgrounds, it is recommended to collect data from multiple universities, to get a better understanding of civil engineering students' personal value systems across different demographical factors, and thus further observe how these personal values may change over time and demography.

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