Well-Endowed Rating Systems: How Modified Defaults Can Lead to More Sustainable Performance

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Abstract: Rating systems are often used as design/decision tools to evaluate, grade, and reward infrastructure projects that meet sustainability criteria such as reductions in greenhouse gas emissions, preservation of wildlife habitat, and accessibility to community cultural resources. Embedded within any such rating system is *choice architecture*, which refers to the way information is presented to a decision maker. This research examines the impact on design choices of changes to defaults in the choice architecture of the Envision rating system for sustainable infrastructure. Currently, the default score in each category of Envision is zero points. Points are earned by improving upon industry norms. To test the impact of changing these defaults, participants (senior-level and graduate students) randomly received either the current Envision version or a modified version with a higher default score, endowing participants with points in sustainability. All participants used their randomly assigned rating system to design an outdoor community center and stream restoration brownfield site. Simply modifying the default, by endowing points, led to setting significantly higher design goals. There were no significant differences in other variables measured, including student motivation or perceptions about Envision or sustainability. These findings suggest that how choices are presented to engineers influences their decision-making process and can lead to higher sustainability goals. The construction engineering and management community can use this understanding to encourage more desired infrastructure outcomes. **DOI: 10.1061/(ASCE)CO.1943-7862.0001009.**

Introduction

Choice architecture refers to the many different ways information can be presented to a decision maker and how the framework of choices inevitably influences the decision (Thaler and Sunstein 2008). Even when two methods of posing a choice are formally equivalent, each presentation may give rise to different psychological processes. Choice architecture can be socially beneficial, as seen when driver's license applicants are asked to check a box on a form if they do not want to be an organ donor. In countries where this opt-out choice architecture is in place, the percentage of organ donors is significantly higher than in opt-in formatted countries that require license applicants to check a box stating their wish to be a donor (Johnson and Goldstein 2003).

Choice architects, those who design choices, are comparable to building architects. Just as there is no neutral building architecture, the size, shape, and materials of a building determine how users interact with the space. There is no neutral choice architecture: presenting options before others, grouping options together, preselecting choices, or framing attributes has positive or negative influence decisions (for more on choice architecture methods see Johnson et al. 2012; Thaler and Sunstein 2008).

Choice architecture theory is being applied to improve decision processes in fields from medicine to law to finance [e.g., organ donation (Johnson and Goldstein 2003), tort law (Johnson 1993), retirement savings (Madrian and Shea 2000). These same choice architecture theories appear to have potential to improve decision processes in infrastructure development. Engineers, architects, contractors, and other groups who design and build infrastructure often consult with planning tools such as the Envision rating system as they develop designs. The study described in this paper examines Envision's current choice architecture and explores changes to its default settings to encourage higher sustainability goal setting.

Envision is used to evaluate, grade, and reward construction projects for meeting sustainability criteria such as reductions in greenhouse gas emissions, preservation of wildlife habitat, and accessibility to community cultural resources. Founded by the American Society of Civil Engineers, the American Council of Engineering Companies, and the American Public Works Association, Envision is meant to be applicable to all infrastructure projects, i.e., roads, bridges, pipelines, railways, airports, dams, levees, landfills, and water treatment systems (ISI 2012), a uniquely broad application among sustainability rating systems (Clevenger et al. 2013). For example, Leadership in Energy and Environmental Design (LEED) for New Construction is limited to improve a building's sustainable design only after the decision is made to construct a new building. Envision is meant to help decision makers choose which type of infrastructure, if any, is most sustainable for surrounding networks. Envision is a two-stage assessment. Stage one is a checklist for conceptual planning and early design. The checklist helps educate the project team about the assessment criteria and works to establish project goals and priorities (ISI 2012). Stage two in the rating system is intended to guide design, engineering, and construction decisions using a weighted scale of points. For example, stage one asks, if low impact development (LID) techniques will be implemented on the project. This is a simple yes or no question. Stage two asks *which* LID techniques will be implemented and how they plan to implement them. The authors' research focus is the stage two rating system, where it is more likely specific design details will be considered.

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The stage two rating system awards points in 60 credits distributed under five categories (ISI 2012): Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Risk. Like LEED, these points accumulate towards a certification: Acknowledgement of Merit, Silver, Gold, or Platinum. Envision distributes points by achievement levels. Users choose to meet one of five levels: *improved, enhanced, superior, conserving,* or *restorative*. A project that *improves* the natural world receives fewer points than a project that *restores* the natural world. Users then explain how they plan to meet the level of achievement chosen. The number of points and application varies by credit. For example, reducing greenhouse gas emissions at the *restorative* level achieves 25 points, while assessing climate threats can only achieve the *conserving* level, at 15 points (ISI 2012). Credits are evaluated through lifecycle assessment calculations or written narratives (e.g., explain the steps taken to receive community feedback). Once these evaluations are completed by the project team, they can be submitted for Envision's third-party verification and certification.

Objective

This paper builds on previous research in construction engineering management that suggests judgment and decision making, cognitive biases, and social heuristics distort managerial decisions in complex infrastructure governance, planning, and delivery (van Buiten and Hartmann 2013; Beamish and Biggart 2012; Klotz et al. 2010; Klotz 2011). Understanding choice architecture in engineering decision frameworks can help reduce these biases (Shealy and Klotz 2014) and inform the new project manager needed to lead complex project delivery teams (Taylor et al. 2014).

The use of Envision is to illustrate how small changes in the choice architecture of engineering decision tools can influence decision processes and goal setting. Envision is the leading sustainability framework for infrastructure project planning. Cities such as Berkeley, California, employ Envision to help prioritize backlogged projects (City of Berkeley 2013). The Port of Long Beach is measuring success of the Pier A West brownfield remediation project using the Envision rating system (Sheesley et al. 2014) and the Los Angeles–San Diego–San Luis Obispo (LOSSAN) Rail Corridor is currently being evaluated using Envision (Dial et al. 2014). The LOSSAN project will set a baseline for future rail corridor project development sustainability.

While detailed design decisions must negotiate between time, budget, and project goals, the decision point the authors are trying understand is earlier in project planning, where goal setting holds high influence on future decisions related to time and budget. This is in line with the recommendations made in the LOSSAN rail corridor case study, which suggests had Envision been adopted earlier in the design process, greater project sustainability points could have been achieved at no additional cost. This study recreates this upfront planning scenario to empirically test if changes in the Envision framework cause a shift in project goal setting. Other variables, like time and budget, are held equal.

Background: Envision As a Choice Architecture Tool

Choice architecture is inherently embedded within the Envision framework: credits are partitioned into categories, achievement levels are associated with points, points are supported by detailed descriptions, and a default number of points are awarded to users. Intuitively or deliberately, these features may influence the decision process.

The authors found numerous connections between established choice architecture theories and the Envision rating system framework. An excellent review of choice architecture is presented in Johnson et al. (2012). The authors started with this review and examined each theory's supporting literature and underlying psychological process. For example, defaults were presented in Johnson et al. (2012) as an application to decision inertia. Thus, the authors reviewed applications of defaults in investments (Madrian and Shea 2000), insurance (Johnson 1993), and organ donation (Johnson and Goldstein 2003). The authors also sought to understand the underlying psychological processes in each application. For defaults, this led to judgment and decision-making literature in goal framing (Heath et al. 1999; Levin et al. 1998), satisficing (Weber et al. 2007), and loss aversion (Khaneman and Tversky 1979). Then, searches for these same psychological processes in other fields led to literature in energy policy (Houde and Todd 2010), consumer behavior related to energy consumption (Allcott 2011; Ayres et al. 2012), and environmental psychology (Nolan et al. 2008). Across fields, choice architecture concepts are viewed as a method to improve the decision process (Thaler and Sunstein 2008).

This literature review method uncovered four parts to Envision's choice architecture, which appear to aid the decision process. The first three are structured within Envision as suggested by choice architecture literature and are presented as illustrative examples that improve the decision process. The fourth choice architecture embedded within Envision is not aligned with the literature and is the focus for this empirical investigation.

Partitions Improve the Decision-Making Process

When presented with too many options, people can become overwhelmed, indecisive, unhappy, and even refrain from making a choice—a phenomenon called choice overload. Grouping decisions by features and presenting questions in a linear framework are shown to reduce the feelings produced by choice overload and reduce the time needed to make a decision (Fox and Langer 2005; Martin and Norton 2009). Each choice within the given partition will likely receive the same amount of decision time and weighting (Levav et al. 2010).

Envision groups 60 credits into five categories. These categories are subdivided and related credits are linked together. For example, Quality of Life includes three subcategories: purpose, community, and wellbeing. Envision draws connections between credits QL1.2: Stimulate Sustainable Growth and Development and QL1.3: Develop Local Skills and Capabilities because both credits deal with attracting businesses as a method to create local jobs. Partitioning credits under subcategories and showing connections to other credits provides a systemic method to navigate the system, which possibly reduces choice overload. Rather than seeing all 60 credits at once (each with approximately five levels of achievement for a total of 275 decisions), users have a limited vantage point, seeing only one partitioned category at a time. Partitions are also likely to balance users' time and decision weight between categories. For instance, features like climate risks, which typically receive little consideration in project planning, may now receive equal consideration to features like resource allocation or project finance risk.

Overcoming Status Quo Bias through a Reward System

Status quo bias is the reluctance to change one's current position. In Pennsylvania, the status quo for auto insurance is the *Full Right* to sue and challenging the status quo means asking for the *Limited Right* to receive a discount. In New Jersey, *Limited Right* represents the status quo and policyholders must actively ask for *Full Right*. Johnson (1993) showed that the reluctance to break status quo meant 75% of Pennsylvania motorists obtained Full Right yet only

20% in New Jersey. This difference translates to more lawsuits filed in Pennsylvania (Fischhoff and Kadvany 2011).

Envision is a decision tool that guides infrastructure engineers away from conventional practice. Plans that keep with convention (status quo) receive no points, while plans to achieve the *restorative* level receive the greatest points. The decision to use Envision, or not, is like that of car owners deciding between Limited and Full Right to sue. Envision helps with how, but the motivation to change the status quo must come from somewhere else. The City of Dallas, the Port of Long Beach, and Massachusetts Water Resource Authority are making that movement. Each requires project teams to use Envision to submit a proposal. Just as car owners trade benefits (limited right to sue) for cost (high risk) infrastructure teams may feel similar trade-offs. Moving away from the conventional industry design may perceive higher risk. The benefit can be a new project, public recognition, or possible monetary bonuses from owners. As the new requirement to use Envision is implemented, firms will decide if the benefit is worth the potential risk.

Detailed Descriptions Increase Confidence

Past experiences, or subject knowledge, can inform current decisions. However, this can lead to overconfidence in judgment of risk. For example, someone knowledgeable in football will feel more confident about predictions in obscure football events than in gambles of chance (such as a coin toss), even when the probabilities of both are exactly the same (Fox and Tversky 1998; Heath and Tversky 1991). To shift cognitive focus away from decisions based on experience, choice architects can provide more detailed descriptions of the options they want users to consider (Erev et al. 2008; Khaneman and Tversky 1979). In essence, the extra description counterweights past experience, changing how information is collected then processed through the brain.

When engineers use previous construction knowledge to justify current project performance and partnerships, their current decisions have been informed by their prior experience (Hartmann and Bresnen 2011). If past decisions kept with the industry norm, a reluctance to depart from these norms can develop and may led to underweighting innovative design solutions (Beamish and Biggart 2010). Envision shifts decision weighting from experience to description by prompting users with questions about how the design team plans to explore new options. For example, "Has the project team identified and assessed possible changes in key engineering design variables?" (ISI 2012). To answer these questions, Envision provides documentation and links to technical details of engineering design. This added information might improve user confidence levels and motivation to create new designs that meet longer-term objectives.

Defaults as a Choice Architecture

While partitions, points, and details create an Envision framework that guides users during the decision-making process, the authors believe more can still be done to encourage the highest levels of Envision achievement—in particular, meeting *conserving* and *restorative* goals. This section explores whether changes to one type of choice architecture, defaults, may impact design outcomes. Each category of Envision begins at a default of zero points, and infrastructure projects can earn points by improving upon the industry norm. The authors study whether a more ambitious default, set to *conserving* (four levels above the current default), will lead to higher point scores. Users who uphold the default keep the points at the *conserving* level. While users that move to the industry norm lose the endowed points and receive a lower score. Changing the default option may shape users' preferences about sustainability choices differently and, as a result, infrastructure projects may achieve higher points. This paper explains how these user preferences are constructed. And while there are many choice architecture strategies, the focus here is on defaults to construct user preferences about infrastructure design options. The rationale used is supported by query theory, in which choices are made based on a linear series of questions and these questions are dependent on the starting point, or default (Johnson et al. 2007). Initial questions produce longer richer responses than later questions and, subsequently, this impacts the outcome (Weber et al. 2007).

Defaults can influence the linear series of questions in three ways: *effort, endorsement,* and *reference dependence* (Dinner et al. 2010). *Effort* references the cognitive energy exerted to make a decision. Employees who do not select a 401(k) plan, displaying a lack of *effort* to make a decision, still save money because of a predetermined default of 3% annual investment (Madrian and Shea 2000). *Endorsement* means decision makers perceive the default as the recommended option because it reflects the most commonly chosen or fits within the social norm (Brown and Krishna 2004; McKenzie et al. 2006). Shoppers who believed a manufacturer's default product option was selected in earnest, representing the best features and not solely the most expensive, were more likely to stay with the default option (Brown and Krishna 2004). *Reference dependence* means the default frames the outcome as a loss or gain and this frame impacts the decision (Dinner et al. 2010). Car buyers first shown the *fully loaded* package perceive lesser models as having lost features (Park et al. 2000). Meanwhile, car buyers first shown the base model perceive those same features as add-ons. This feeling of loss or gain is reference dependent on the starting point. This study examines the impact on upfront planning and engineering design choices when changes are applied to the Envision rating system's default settings.

Hypothesis

This study suggests Envision users make infrastructure decisions in a way similar to consumers, by constructing preferences about options. Table 1 shows an example credit. Users start with zero points and must decide the level of achievement and number of points to obtain. These preferences are dependent on the reference point, or default. This study also suggests that Envision's current default may unintentionally discourage users from achieving the even higher levels of sustainability performance that are possible. By changing the Envision default from the industry norm to the *conserving* level of achievement, users will achieve more points (i.e., subtract less) and create more sustainable designs.

Table 2 shows the modified scale developed to test this idea. Currently arranged, Envision awards 1 point (*improved*) for creating a spill prevention plan and 14 points (*conserving*) for eliminating all potential polluting substances. The modified scale, endowing points to the user, makes the 14-point option the default. Additional points are only possible by achieving the highest level, *restorative*. Achieving below the new default results in a loss of points. Now, rather than adding 1 to the 0 endowed points, a spill

Table 1. Example of Achievement Levels for Credit NW2.3: Prevent Surface and Groundwater Contamination

Possible points	Levels of achievement	Description
1	Improved	Design for response
4	Enhanced	Long-term monitoring
9	Superior	Design for prevention
14	Conserving	Design for source elimination
18	Restorative	Remediate existing contamination

Table 2. Modifications to Envision Rating Scale for Credit NW2.3

Levels of achievement	Current scale	Endowed scale
Industry convention	0[a]	(−14)
Improved	1	(−13)
Enhanced	4	(−10)
Superior	9	(−5)
Conserving	14	14[a]
Restorative	18	(+4)

[a]Indicates default number of starting points.

prevention plan subtracts 13 from the 14 points that were endowed. The *conserving* level of achievement was chosen as the endowed default because it represents the environmental neutral defined by Envision. This means the infrastructure development plan neither harms nor improves the surrounding community or environment (ISI 2012).

The final amount of points for each level of achievement remains the same in both versions. The only change is the process to achieve them. The authors examine whether this simple restructuring will change user preferences about options and ultimately lead to a higher level of sustainable design achievement.

The hypothesis about endowment follows Khaneman and Tversky's (1979) study that found a loss provokes greater degrees of discomfort than a gain provides satisfaction, by roughly a factor of 2. People who own an item value its worth twice as much than if they did not own the same item (Thaler 1980). Functional magnetic resonance imaging (fMRI) brain scans show physical differences in people asked to add (gain) or subtract (loss). Subtraction takes more cognitive energy and occurs in regions closer to the emotional region of the brain (Gonzalez et al. 2005; Yi-Rong et al. 2011). The effects of framing (loss or gain) take little time to establish (Khaneman et al. 1990), suggesting that changing the default in Envision may be enough to promote higher scores. Envision users currently gain points. Shifting Envision users from a point gain to a point loss frame may lead to higher motivation to keep the points in an effort to avoid the discomfort felt by a loss.

This study builds on previous judgment and decision-making research but differs in several ways. This is the first study to the authors' knowledge that empirically examines how modifications to choice architecture impacts infrastructure decisions. A default is set with points rather than product features, which may lead to different outcomes or perceived value. Envision users are not choosing options about a product for purchase, but rather to influence a physical design, and this may cause users to construct preferences differently than previous studies suggest. The authors are also asking questions with multiple attributes, meaning users are choosing between five options, not just opt-in or opt-out choices. This may alter the degree of influence of the default option on the decision maker.

Method

The empirical portion of this study examined student decisions when using the Envision rating system. Student participants from an undergraduate sustainable construction course were given a case study and asked to choose design options from two of the five Envision categories: *Quality of Life* and *Natural World* (26 of the 60 available credits). These categories asked participants how to improve community mobility, preserve cultural resources and green fields, and manage stormwater runoff. Other Envision categories were not included to reduce the time and the cognitive load required to complete the assignment. Students were encouraged to spend time thinking about the design choices, rather than rush through to complete all of the credits.

Participants were given class credit for completing the rating system. Their grades were based on turning in the assignment, not on their achievement score. This was made clear during the lecture introducing the assignment and in the case study instructions. Participants accessed the assignment via an internet link, through which they were randomly directed to one of two Envision versions: the standard version with 0 points or the endowed version with 304 starting points. Instructions on the endowed version read "Decisions made below the *conserving* level will lose you points. Decisions made above the *conserving* level will earn you points." Instructions on the standard version read, "You are starting at the industry norm benchmark with 0 points. Every decision you make above industry norm will earn you points."

As students completed the rating system through the online portal, the software captured each design decision and written explanation. The online software also allowed the authors to set a minimum number of words for each explanation. For example, selecting the *improved* level required 100 characters of explanation and the *restorative* level required 300 characters. This word minimum was included to reduce the likelihood that participants would maximize points by thoughtlessly selecting the highest levels of achievement for every credit. The word minimum acted as a sort of cost, in terms of the time and thought required to justify the achievement choice. Based on feedback from preliminary studies, character minimums (rather than word minimums) were used and a 50-character increase was given for each higher achievement level. Users were able to identify credits as not applicable to the project if they could justify why the credit was not applicable. Points for credits selected as not applicable were deducted from the total achievable points in the system.

As mentioned earlier, budget and time were intentionally excluded from the online software. The objective was to measure how users set project sustainability goals. A high sustainability score does not correlate with an increase in project cost and Envision does not include an economic decision metrics. Developing a monetary cost for each decision within Envision may introduce biases not controlled for. The Envision system was kept exactly the same except for the intervention to default number of points and required length of explanation. Isolating this decision point allows to measure the difference between groups as a result of the choice architecture intervention.

Often, the influence of choice architecture is unnoticed by decision makers and a difference in dependent variables is minimal (Thaler and Sunstein 2008). To see whether participants were affected by the different defaults in ways other than score, the authors asked survey questions related to intrinsic motivation and confidence. The authors define motivation as importance and effort and measured if the endowed default created greater participant motivation to not lose points compared to the industry norm group who gained points. Eight survey questions were adapted from previous post-task motivation surveys (Fernet 2011; Thelk et al. 2009; Watson et al. 1988; Wolf and Smith 1995). Additionally, the authors asked if participants achieving above or below the 304-point default were confident a project team could meet their scores and compared responses to the 0-point default group. If not meeting the 304-point default discouraged participants to use the Envision system in the future, a higher default may not be preferred.

Participants were asked if they were aware of the default and to explain if this influenced their decision process. Mindful, or not, participant's responses would provide supporting evidence for or against our theoretical basis of query theory. The authors also asked for additional information about any previous internships or jobs related to the case study topics. Survey questions included both Likert scale (1 = strongly disagree to 5 = strongly agree) and open-ended response.

Procedure

During an in-class lecture, undergraduate student participants in a sustainable construction course learned about Envision's purpose and how to navigate the rating system and use to select project features. Participants were asked to pretend they were a sustainability coordinator for a project team designing an outdoor community center and stream restoration on a 0.4-acre brownfield site in rural Alabama. The Envision system would help them make site design decisions about cleanup, restoration, and construction. Participants were given background material about the site such as its Environmental Protection Agency's brownfield Environmental Assessment report and the community revitalization mission statement. Details like how to clean site contamination, whether to include bike paths, and where to place the outdoor community center were not provided. Each participant used the Envision credits to make individual decisions. For example, Credit NW2.2 asks if low impact development (LID) guidelines were used to manage stormwater runoff. For this credit, participants reviewed specific LID guidelines, provided by the online rating system, and then decided whether and how to incorporate LID features into the project. Participants designed based on 26 credits, evaluating which were most valuable, achievable, and in line with project goals.

Results

As hypothesized, a higher default led to a higher final score. The endowed group ($n = 16$) averaged 62% (214/343) of applicable points and the standard group ($n = 25$) averaged 44% (147/329). A one-tail t-test was used because the hypothesis states the endowed group will score significantly more than the standard group ($p < 0.01$). Only two students from the endowed group achieved higher than the *conserving* 304-point default. Thus, most endowed group participants lost points, while all standard group participants gained points.

If all credits were considered applicable, the total possible achievable points would have been 384. Over 75% of all participants selected at least one credit as not applicable to the project. There was no significant difference in points considered applicable between the endowed group (343 points) and standard group (329 points, $p > 0.1$). The endowed group achieved significantly more of the points considered applicable to the project ($p < 0.01$). The endowed group received the Platinum level of recognition (achieving over 50% of applicable points), while the standard group received the Gold level of recognition (achieving between 40 and 50% of applicable points). The average completion time was 1 h, 56 min to complete the rating process. For completion time, there was no significant difference ($p > 0.1$) between groups.

The total scores were evenly distributed between categories, meaning participants equally prioritized Quality of Life and Natural World credits. The endowed group achieved 68% (117/172) in Quality of Life and 60% (97/171) in Natural World. The standard group averaged 43% (71/167) in Quality of Life and 46% (75/163) in Natural World. The difference between groups is statistically significant for Quality of Life ($p < 0.01$) and Natural World ($p = 0.04$). Median values for each category were within five points of the average scores. The results, shown in Table 3, are the percent of total points achieved by the total points selected as applicable.

Table 3. Standard and Endowed Percent Points Achieved

Participant groups	Achieved score	Possible score	Percent achieved	p
Standard	147	329	44%	<0.01
Endowed	214	343	63%	

Survey responses indicated no difference in student motivation between groups. Those in the endowed group (losing points) and those in the standard group viewed the rating process as requiring similar effort and having similar value. Additionally, the authors asked if those achieving above or below the 304-point default were more or less confident a project team could meet their scores and compared responses to the 0-point default group. Both groups were equally confident in their scores. And while the number of participants who scored above the *conserving* default was low, only two participants believed their scores were average, not above the rest of the class. Participants from the endowed group who lost points indicated they were happy with their scores and, when compared to those in the standard group, no significant difference was found in responses.

It was thought that the new default may lead those in the endowed group to view *conserving* as required for true sustainability. However, both groups indicate a project could be considered sustainable with only the incremental advances rewarded by the *improved* level of achievement.

Participants in the endowed group were asked if they were aware of the default and to explain whether this influenced their design decisions. Of the 15 who answered the survey, just two correctly answered 304 points as the default starting point. Seven participants provided an incorrect value, and six indicated zero points. Seven of the nine participants that indicated the default number of points were greater than zero indicated the default did influence their decisions. Open-ended responses captured participants' explanations. A participant mindful of the default explained, "I at least tried for *conserving* each time. I looked at the requirements for *conserving* and then thought how I could make the project reach that requirement." Another participant said, "I started at the default setting, and tried not to lose points." These responses suggest a higher default can shift a decision-maker's perspective without negatively representing the Envision rating system. In fact, the two highest scores, the participants who achieved 92 and 91% of the total possible points, were students who indicated on the survey they started with the *conserving* level of achievement and tried not to lose points.

Discussion

This paper's findings indicate that Envision's current default preserves a low benchmark of achievement, which reduces the possible higher levels of achievement that are possible. The higher default led designers to achieve the highest possible certification given by Envision. Envision denotes certification by a percent of points: Certified (20%), Silver (30%), Gold (40%), and Platinum (50%). The endowed default increased recognition from Gold to Platinum, an average increase of 19%.

These findings support previous research in consumer decision making that states defaults influence how decision makers process information (Levin et al. 2002; Park et al. 2000). The findings also align with query theory. The higher default orients users to a higher level of achievement and, subsequently, this affects the outcome. Based on their responses to the survey questions, the endowed group appeared more likely to review requirements at the *conserving* level of achievement and then decide to move up or down in levels. While some participants in the endowed group were more aware of the manipulation than others, it was an effective method to increase the average sustainability score.

In some instances, defaults mean that when no choice is selected a decision is still made (Brown and Krishna 2004). In these cases, defaults obviously help reduce the cognitive energy needed to make a decision (Johnson et al. 2002). However, in the present study, the endowed default still required cognitive energy to make a decision. Levav et al. (2010) suggest a depletion effect where, as more decisions made, fewer cognitive resources are available for future decisions. The participants of the present study did not seem to experience this depletion effect; both groups answered credits similarly in the beginning of the activity and towards the end. This may be due to participants prioritizing credits prior to beginning the rating process. Also, participants in the endowed group may have taken cognitive energy saved from the *conserving* default, and devoted it to explaining their plans to meet the *conserving* level.

Previous research suggests defaults can endorse a choice as a social norm (McKenzie et al. 2006). However, the limited findings from the survey questions did not support this. Participants from the endowed group did not view their scores differently than the standard group. The endowed default did not change participant's perceptions about sustainability or the Envision rating system. Those who met the *improved* level of achievement felt equally confident and happy in their score as those that met the *conserving* level of achievement.

It was thought the endowed group may feel greater motivation to meet the higher default, but no statistically significant difference was found in self-reported posttask motivation responses between the two groups. Participants from the endowed group who could recall the correct default number of points achieved the highest percentage of points out of all 41 participants. Placing even more emphasis on the default may lead to even higher scores, which is worth exploring more through the future studies described in the Conclusions.

Those interpreting these results should keep the following qualifications in mind. Preliminary design goals often change due to monetary budgets, project schedules, and multiple stakeholder objectives. One cannot know how these early design decisions would hold through to the physical manifestation of the project. However, research in anchoring suggests a higher initial score influences future decision making (Chapman and Johnson 1999; Galinsky and Mussweiler 2001). Starting with a higher preliminary Envision score could help guide a project team to achieve a higher final score. Engineering firms could benefit from the modified Envision version when working with cities like Berkeley, California, which use Envision to help prioritize backlogged infrastructure projects. Additionally, participants were aware this was a one-time assignment. While there was no external motivation to embellish their design or choices, there were also no limitations to doing so. These student participants were enrolled in a sustainable construction course and already interested in sustainability topics. However, Envision is also a voluntary tool and those using Envision will most likely be interested in sustainability achievement. Because these results are based on student responses, one cannot be sure these defaults would influence professionals in the same way. However, previous studies with experts and novices would suggest similar conclusions (Englich et al. 2006; Northcraft and Neale 1987). A follow-up study can replicate these research methods with an industry group to confirm whether findings are transferable to professional engineers.

Conclusions

Defaults are a specific type of choice architecture that determine how users initially encounter options. Simply prechecking a box is a powerful first impression. Private retirement plans with defaults set to invest increase user savings (Cronqvist and Thaler 2004; Madrian and Shea 2000). Online shoppers purchase more expensive items when multiple product options are available and set to the highest priced default option (Herrmann et al. 2011). Unlike in previous studies, the decision makers of this study are not consumers but professional decision makers (in training at least), people whose decisions will eventually influence physical infrastructure. Construction engineering and management professionals can use choice architecture to help inform upfront planning and decision making. Researchers can study how choice architecture embedded in standards, procedures, and frameworks influences the decision process for infrastructure delivery and how changes to the choice architecture might influence the decisions that are made. For example, as this study shows, awarding points for slight improvements unintentionally discourages the higher levels of achievement that are possible. Shifting the default to *conserving* reframes the internal questioning process of the decision maker and subsequently encourages higher levels of achievement.

Smartly designing the choice architecture of decision tools like Envision is a comparatively low-cost method to meet societal obligations to create more sustainable infrastructure, ensuring functionality for future generations (ASCE 2009). This study's findings are just one example of the advances possible at the intersections of behavioral science and infrastructure planning.

The Envision framework allows analysis of preference construction both quantitatively through changes in point values and qualitatively through design verification descriptions for each credit. Specific to Envision, additional choice architecture studies could explore changes in commitment framing, goal framing, and greater emphasis to the reference point. For example, changing commitment could require users to explain why they could not meet the highest level of achievement. Credit NW 3.4 *improved* currently asks, "Does the project maintain or enhance one ecosystem function?" By reversing the commitment role, users would now "Explain why the project could not maintain or enhance all ecosystem functions" to meet the *conserving* level. This change in framing strongly implies a higher commitment, and may lead to higher achievement.

Goal framing provides rules for setting a goal. Set too high and users may perceive the goal as unattainable and score less (Heath et al. 1999). In the present study, participants viewed the *conserving* level of achievement as attainable and worked to achieve it. Future research should set an even higher default to identify when participants view achievement as too extreme. Another study could redesign the format of the rating system to place greater emphasize on the score. The participants in this study that could recall the endowed default scored the highest percentage of the points. More emphasis on the score may increase awareness of the starting point and possibly lead to even higher achievement. Finally, an active intervention could teach participants why the *conserving* score is the least possible level for true sustainability and show examples of how this level is attainable.

Envision is just one of many decision tools for infrastructure planning and similar approaches could be applied to others. For instance, understanding how an engineer constructs preferences about material options when using building information modeling (BIM) could help identify if shifting the order of options, number of clicks, or default settings influences a change in choice. Engineers that use Intelligent Transportation System (ITS) software may perceive computer-based models as less risky than other forecasting methods due to the large data sets used to create the computer simulations. Through feedback loops one can identify how these forecasts impact project outcomes and analyze if these high confidence levels are confounded. ITS and BIM are two examples that hold high-impact decisions yet to be examined through choice architecture.

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