

Review

Socio-Psychological Perspectives on the Potential for Serious Games to Promote Transcendental Values in IWRM Decision-Making

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Abstract: Modern day challenges of water resource management involve difficult decision-making in the face of increasing complexity and uncertainty. However, even if all decision-makers possessed perfect knowledge, water management decisions ultimately involve competing values, which will only get more prominent with increasing scarcity and competition over resources. Therefore, an important normative goal for water management is long-term cooperation between stakeholders. According to the principles of integrated water resource management (IWRM), this necessitates that managerial decisions support social equity and intergenerational equity (social equity that spans generations). The purpose of this discussion is to formulate preliminary recommendations for the design of serious games (SGs), a potential learning tool that may give rise to shared values and engage stakeholders with conflicting interests to cooperate towards a common goal. Specifically, this discussion explores whether SGs could promote values that transcend self-interest (transcendental values), based on the contributions of social psychology. The discussion is organized in the following way. First, an introduction is provided as to why understanding values from psychological perspectives is both important for water management and a potential avenue for learning in SGs. Second, a review of the description of values and mechanisms of value change from the field of social psychology is presented. This review highlights key psychological constraints to learning or applying values. Based on this review, recommendations are made for SGs designers to consider when developing games for water management, in order to promote transcendental values. Overall, the main conclusions from exploring the potential of value change for IWRM through SGs design are as follows: 1-SGs design needs to consider how all values change systematically; 2-SGs design should incorporate the many value conflicts that are faced in real life water management, 3-SGs could potentially promote learning by having players reflect on the reasoning behind value priorities across water management situations, and 4-value change ought to be tested in an iterative SGs design process using the Schwartz's Value Survey (SVS) (or something akin to it).

Keywords: serious games (SGs); water management; value change; transcendental values; social equity; sustainability; Schwartz's Value Survey (SVS); Integrated Water Resource Management (IWRM); psychosocial perspectives; decision-making processes

1. Introduction

Globalization, pollution, scarcity, social inequity, and climate change are issues that demand the attention of researchers and practitioners across various disciplines. There is a growing sense of urgency to implement innovative policies and management strategies, as our global natural resources are facing increasing pressures from population demand and the uncertain consequences of climate change. In response to complexity across natural systems and socio-political domains, there has been a shift from traditional reductionist approaches towards management strategies that integrate both socio-political and scientific dimensions. This is often referred to as “integrated natural resource management” (INRM), [1–3]. INRM strategies have evolved to incorporate adaptive management strategies. Adaptive management (AM) demands continuous and purposeful progress through monitoring and adaptation, to address the unpredictability of our natural resources [3,4].

Integrated water resource management (IWRM) offers an approach to management (under the INRM umbrella) that specifically addresses modern global freshwater challenges [3]. IWRM is defined by the Global Water Partnership as “a process that promotes the coordinated development and management of water and land resources, in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” [5]. IWRM moves beyond the traditional management approach of “command and control”, which assumes the predictability of stable water sources, as well as that these resources should be manipulated through technological engineering solutions in order to increase supply [3,6,7]. Its principles are based on public participation, economic efficiency, social equity, and ecological sustainability, and a key feature of IWRM is to manage freshwater resources at the scale of the watershed, involving land management, various stakeholders, and transcending administrative and political boundaries. The practice of IWRM has further evolved to incorporate adaptive management strategies that involve the continuous monitoring, learning, and improvement of methods and policies to address a continuously changing environment [3] (p. 25). Despite a growing popularity of IWRM principles and practice across the globe, key challenges remain that need to be addressed [8–10]. Barriers to IWRM implementation are often related to inefficient governance structures, lack of scientific and predictive knowledge, lack of engagement or cooperative action between stakeholders, and the limited capacity of IWRM management organizations [11,12]. Other difficulties in implementing IWRM are due to the complexity of coordinating socio-political boundaries with natural resource management that involve multiple temporal and spatial scales [13]. Scholars (across many disciplines) are exploring ways to address these challenges in order to achieve the fairness and sustainability of freshwater resources.

Collaborative forms of governance, such as IWRM and AM, are considered essential to solving complex sustainability problems and, as mentioned, require the bridging of various physical, administrative, and socio-political boundaries [14]. Human behavior changes with time, and the advancement of information and communication technologies (ICT) offers innovative means to help span these boundaries and contribute to collaborative solutions to sustainability problems, while fundamentally transforming interactions and relationships between governments, firms, non-government organizations (NGOs), and civil society [15,16]. Although the emerging field of ICT-enabled boundary spanning is still in its infancy, there is a general agreement that advanced ICT (e.g., interactive apps, virtual platforms and communities, serious games, and civic hackathons) provide novel tools to expanded collaboration across boundaries [17], as well as mechanisms to accelerate transformational change in (a) perception and meaning; (b) underlying norms and values; (c) social networks and patterns of interaction; and (d) power structures [18].

Serious games (SGs) that combine computer simulations with role-play as an integrated method for complex policy- and decision-making are particularly promising [7,19] and will be the focus of this research. Over the last decade, this type of game simulation has become more prevalent [20] in education, including teaching water management (e.g., [21,22]), water governance and policy (e.g., [23,24]), and other common-resource management fields (e.g., [25,26]). Although the professional and academic debate on the potential of serious games has quite a tradition (e.g., [19,20,27,28]), there

are diverging opinions regarding the impact of such games on policy and decision-making [29], as well as on behavior change and learning outcomes [30].

Gaming technology is increasingly employed to support human learning and foster innovation [31,32]. SGs are defined as games that are designed for an educational value beyond entertainment [33], and are increasingly explored in the context of these modern socio-environmental challenges. From this perspective, SGs are discussed in terms of their potential to address the sustainable governance of natural resources by supporting individuals or groups, as well as providing spaces for collaboration and knowledge co-creation [7,11,12,34,35]. SGs have more recently been explored to support social learning and collaboration in IWRM [11,36]. The educational goals of IWRM games include the development of both soft and hard skills and can also be used to directly support decision-making. For example, one study developed a game to enhance decision-making skills for optimal water system design problems that resulted in observable improvements in the participants' ability to identify appropriate solutions [36]. Alternatively, softer skills in IWRM game design could include policy formulation and conflict resolution in transboundary management, such as in the Shariva (Shared River) game [24]. Additionally, the balancing of economic and environmental goals in sustainable watershed management is addressed in the Aqua Republica game, which can be played by individuals or groups [12].

It is interesting to note how the Aqua Republica game simulation requires its players to address conflicting goals in IWRM decision-making, such as economic prosperity versus environmental sustainability. For instance, short term economic gain, such as building a factory, results in longer term environmental degradation. On the other hand, population increase demands a certain level of economic growth to meet their energy demands. Players are thus challenged to make decisions that optimize both economic and environmental impacts. Here, participants learn policy and technological tools to sustain population growth, while preserving the environment, and are made aware of the negative environmental impacts that result from the sole pursuit of prosperity. However, a key challenge remains on how to promote the pursuit of social equity and sustainability in decision-making beyond the context of the game, in the long-term, across situations. To achieve this, it can be assumed that stakeholders must be continuously motivated to pursue goals beyond their self-interest in real life. These underlying motivations can be understood as values.

From the discipline of social psychology, values are relatively stable cognitive constructs that guide an individual's perceptions, attitudes, and behaviors, and that transcend situational boundaries [37,38]. The study of values may give insight into the potential learning outcomes of SGs that address important IWRM challenges. First, as values guide behavior and perceptions in a way that is not situation-specific, influencing a participant's values from game play could potentially result in tangible changes, beyond the context of the game. Moreover, human values have been shown to be predictive of cooperative attitudes and behavior, such as pro-environmental and charitable actions [39–42]. Also, values are thought to be invoked when reflecting on difficult decision-making that involves trade-offs or novel decisions [43]. Furthermore, values are tied to emotion, an important and often neglected variable when studying human perception, decisions, and actions, especially relating to issues of risk, uncertainty, and the management of natural resources [44–46]. For instance, it is argued that effective behavioral change (specifically in the context of adapting behaviors to mitigate the effects of climate change) should involve methods that invoke more personal and emotional responses [46]. It should come as no surprise then that values, shared values, and cooperation have already been studied in the context of game design [47,48]. Notably, a fundamental difference in values has already been recognized as a constraining factor in learning from SGs play for natural resource management [12].

Values can be evaluated through the perspective of many disciplines, such as philosophy, anthropology, economics, and management [43,49]. Therefore, it is helpful to review the theory of values from a selected discipline. There are several benefits to focus on for the social psychological study of values, which will be the focus of this discussion. The psychological perspective is particularly relevant in

understanding the complex dynamics by which humans interact and shape their environments. This is best described by Bandura, as follows:

“Psychology is the one discipline that uniquely encompasses the complex interplay between intrapersonal, biological, interpersonal, and sociostructural determinants of human functioning. Psychology (is) best suited to advance understanding of the integrated biopsychosocial nature of human and how they manage and shape the everyday world around them” [50].

As values have been extensively studied in the field of social psychology, it is possible for researchers to empirically test them [43,44,51]. Therefore, game designers could potentially validate the effectiveness of their games in promoting certain values. For instance, changes in values from game play could potentially be monitored throughout the iterative design process by accessing well-tested psychological tools (i.e., Schwartz’s Value Survey). Moreover, an important social psychological theory on values, Schwartz’s “Theory of Basic Human Values”, identifies specific values that have been empirically validated across 82 countries [37,51], and its methods of measurement have been tested in diverse cultures across the globe [49]. Therefore, these tools can potentially be used to assess the effectiveness of IWRM games that involve participants from different socio-cultural backgrounds. This is especially important when considering how cross-collaboration across socio-political boundaries are core to the practice of IWRM. All in all, the social psychological study of values may offer tools for game designers to iteratively monitor the effectiveness of their games in promoting IWRM principles, and involve a diversity of participants from different nations across the globe.

Interestingly, the development of certain values has already been presented as an important learning target for the IWRM audience. For instance, a more explicit deliberation of the underlying values (a “values approach”) of governing water resources has been argued to ensure that the management outcomes are actually socially and environmentally sustainable [52–55]. However, even if one diligently pursues the IWRM principles, in practice, values often conflict [56,57]. For example, the increased pressure from population demand and urbanization can make it difficult to balance social equity and sustainability, as it can be difficult to supply the demand without investing in infrastructure that leads to long-term negative impacts on the environment [7] (p. 90).

Conflicting values that arise between stakeholders are being discussed as key water management challenges [56,58]. In practice, conflicts may arise between different applications of water usage (agriculture versus fisheries or energy) and competing groups (transboundary conflicts) [3,57,58]. Importantly, the development of shared values is an important outcome for social learning processes [12], known as “transformation”, where a collection of individuals formulate a common purpose and work towards a shared goal [59]. Social learning refers to the process of learning through others in social settings (that is, of outsourcing information to others, or to a cumulative cultural repertoire of skill, knowledge, and attitudes) [60], where learning outcomes may result in changes in the understanding for a small or large group [61]. Social learning outcomes can also be categorized as cognitive enhancement (such as gaining knowledge) or moral development. The desired “normative” outcomes of social learning involve developing a sense of solidarity with the community (43), synonymous with “cooperative values” or “shared values”, where the well-being of the group is being prioritized over individualistic aims. Changing values is seen as an important outcome of the social learning processes, both at the individual and societal level. Value change is an important potential outcome of social learning processes, namely “double and triple loop social learning”. Double loop learning involves challenging values on an individual or societal level, while triple loop learning involves a change in governance systems as a result of changing values [12,61]. In other words, triple loop learning includes double loop learning and expands this into a transformation of the governing system.

Evidently, values are already being discussed in the context of IWRM learning and capacity building. However, values as a term or concept can be alluded to from various perspectives. Within the study of social psychology, which specific values would be desirable learning outcomes to incorporate in the design of SGs for IWRM? As seen in the IWRM definition, IWRM aims for the pursuit of social

equity and environmental sustainability. Social equity aims to protect the welfare of all human beings, and environmental sustainability ensures that the welfare of future generations are also protected (thus, sustainability pursues intergenerational equity, which is social equity that spans generations). Within this field, the term “transcendental values” specifically refers to values whose underlying motivations are beyond self-interest [51]. As stakeholders are required to make decisions that pursue goals beyond their self-interest in order to align with IWRM principles (social equity and environmental sustainability), we argue that the promotion of “transcendental values” is a desirable learning outcome for SGs. Therefore, the following discussion reviews how the study of values in psychology contributes to the understanding the mechanisms and constraints involved in the promotion of transcendental values. This first requires understanding the theory of values, how values can be changed or influenced, and whether or not transcendental values can be promoted (see Figure 1 below for an overview of the structure of the discussion).

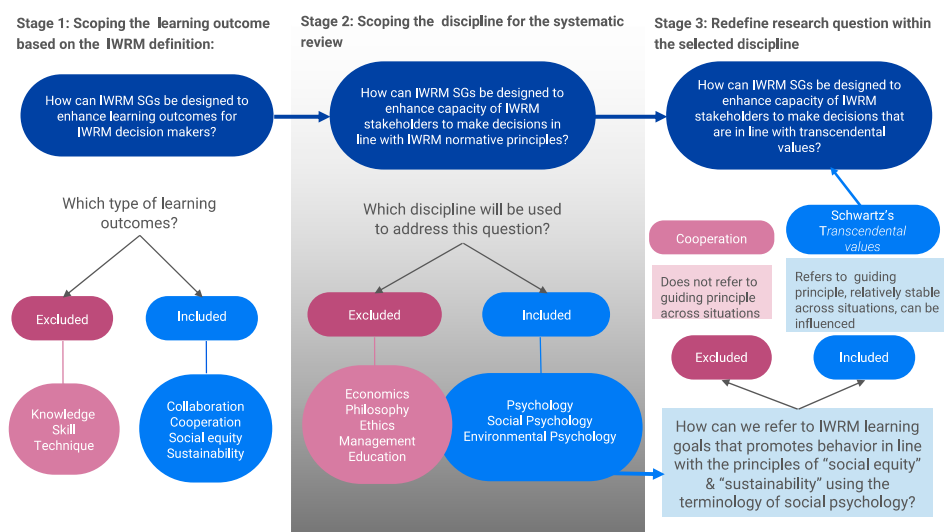


Figure 1. Conceptualization of the following research question: how can serious games (SGs) for integrated water resource management (IWRM) be designed to enhance the capacity of IWRM stakeholders to make decisions that are in line with IWRM’s normative principles?

2. Method

A systematic review of values and changing values from the field of social psychology was carried out as part of this review. As values can be understood differently in many fields, it is necessary to first scope the review within a particular discipline. This review includes peer-reviewed literature within the field of social psychology. The discussion of values from other disciplines, such as economics or philosophy, were excluded. Scopus and Google Scholar were used to search the following terms: value(s), value change, change values, learn values, mechanism value change, environment values, cooperative values, values social psychology, shared values, and transcendental values. The review on the theory of values was used to recommend which specific values from the field of social psychology are desirable learning outcomes for IWRM in SG. Following this, the review of the mechanisms and constraints on how values can be changed or learned was used to develop recommendations for SGs design so as to achieve the desired learning outcomes. A brief review on the relevant topics in SGs applied to IWRM was carried out to incorporate the findings into the results and discussion. Search terms to review these topics were “serious games and water management” and, “social learning and serious games”. Discussions on SGs for IWRM that focus on hard skills (technical, knowledge transfer, technical skills, and knowledge-based skills) were not included. Insights from the review are then used to make recommendations for SG design for the promotion of transcendental values in the context of IWRM (see Figure 2 below for an overview of the overall methodology for this review paper).

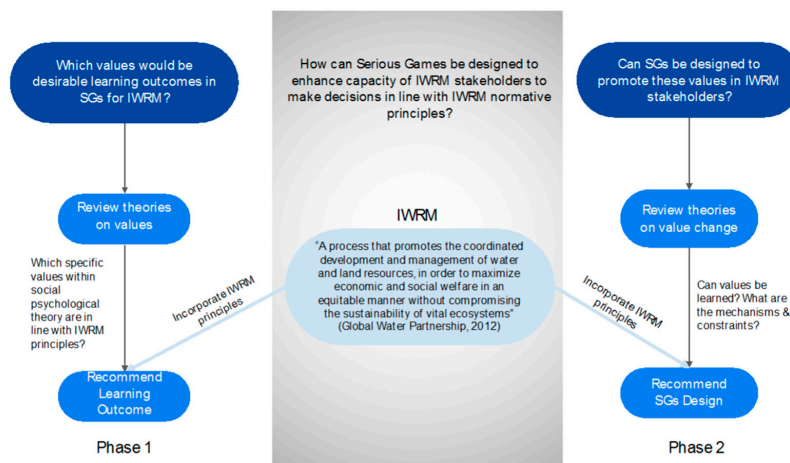


Figure 2. Overall methodology to answer the following research question: how can serious games be designed to enhance the capacity of IWRM stakeholders to make decisions in line with IWRM normative principles?

3. Understanding Values from a Socio-Psychological Perspective

3.1. Behaviorism

In order to contextualize the theory of values from social psychology, we will briefly discuss the study of learning in psychology. Behaviorism is primarily focused on human learning through the objective study of observable behavior, which is often reduced to stimulus–response relationships [62]. From this perspective, values are often tied to expected rewards. Values are implicated in classical conditioning and associative learning. Associative learning can be understood within the theory of classical conditioning (Pavlov, Watson), where a behavioral response is learned for a neutral stimulus by pairing it with a stimulus that had a pre-established behavioral response [63]. As an evolution to Pavlov and Watson’s classical conditioning, Skinner introduced “operant conditioning”, which adds a dimension of personal agency to these earlier theories. His principles have also been used to explain complex behaviors through “behavioral shaping”, and modifying behavior through rewards such as tokens [64]. Several scientists have looked into the neural mechanisms and correlates of associative learning based on behaviorism. For instance, several models utilizing algorithms based on behavioral theories have been applied to understand the neural mechanisms behind learning reward value [65]. In addition, damage to reward centers in the brain (such as the amygdala) can devalue the conditioned stimulus (CS) and thus impede associative learning [63]. Interestingly, humans have been shown to value expected rewards subjectively. For instance, people will favor immediate rewards over long-term rewards, even if the overall monetary gain will increase in the long-term [39] (p. 271).

Some argue that learning values from a behaviorist approach (rewards and punishment) is too narrow and reductionist (oversimplified to stimulus and response mechanics). A common criticism is that behaviorism solely focuses on studying behavioral responses rather than understanding internal mental processes. At the time of its inception (and given the methods of the time), this was an extremely useful method in psychology. An important evolution from these theories was when Bandura posited that people also learn from watching others get rewarded and punished (observational learning), and demonstrated this phenomenon in the 1960s [50]. In the ‘Bobo Doll experiment’, Bandura observed how children interacted with a doll after having watched adults interact with them in an aggressive manner [66]. Bandura’s “social learning theory” (SLT) is built on the classical/operant conditioning models of learning with the addition of the internal cognitive processes that mediate learning between stimulus and response. These cognitive processes allow for individuals to learn new behaviors from others through observation. An important contribution of Bandura’s learning model is that people actively process information. An observation of another’s behavior will be learned (replicated),

depending on the mental processes of (1) attention; (2) retention (memory); (3) reproduction ability (self-efficacy); and (4) motivation. Moreover, when someone identifies (identification) with a model (mode of behavior, like aggression), they tend to move beyond the imitation of a single behavior, and adopt a broader range of the attitudes, beliefs, and values of that model [66].

Although Bandura's theory has evolved significantly, it is still heavily based in behaviorism. Not only does the theory of behaviorism represent a critical stepping-stone for Bandura's SLT, but it is also important in the pedagogical theories of instructional design (ID), such as giving praise to students as reinforcement [67]. Like Bandura, in addition to behaviorism, ID incorporated other theoretical constructs to account for complexity in human learning, such as active information processing, as described by Bandura's SLT [67]. An important theoretical cluster in ID is constructivism, which attempts to counter the over-emphasis of humans as passive recipients of environmental inputs in learning, and incorporate human agency, such as broad complex learning goals, as well as the ability to construct and test knowledge against reality. Notably, Bandura also recognized the over-emphasis of the environment in his SLT and subsequently developed social cognitive theory (SCT) to account for more human agency [50]. All in all, the behaviorist theories of learning have had a great influence on the subsequent learning theories that involve values. Behavior theories and understanding are still relevant, although they are not thought to sufficiently explain human learning and behavior. There has also been a movement towards the incorporation of learning in a social context, as well as the incorporation of human agency in learning models.

3.2. Social Psychological Theories of Values

Although values are discussed in the influential learning theories of behaviorism and SLT, more in-depth discussions can be found from social-psychological contributions. Values have been of interest for a long time in influencing human socio-psychological processes and behavior, but are generally seen as too abstract and vague to measure or describe in detail [68,69]. Values in social psychology can be broadly defined as concepts about desirable states (abstract ideals) that serve as guiding principles for one's life [43,44]. It is important to note that values are distinct from other psychological constructs, namely: attitudes (affective orientation to something specific), traits (not necessarily desired or reflected upon influencers of behavior), norms (ought to statements based on societal demands), needs (biological requirements), preferences (ranking outcomes of a decision), beliefs (understandings of the world), worldviews (generalized beliefs), and roles (behavioral decisions based on social situation) [43]. This distinction is especially important when, for example, discussing an ecosystem valuation that works to put a monetary value to ecosystem services. In these discussions, the valuation of a certain ecological concept, such as water quality, is referred to as a "context value", however this would be an "attitude" or "preference" according to strict social-psychological terminology. Such distinctions are also relevant in comparison to the management or economic literature. For instance, structured decision making (SDM) is a practical approach to improve decision-making for environmental management, and value-focused thinking guides decision making in strategic management. Both recognize how values are core to decision-making processes, and advise stakeholders to deliberate on how "values" are implicated when considering alternative decision outcomes [70,71]. For example, different stakeholders may ascribe different "values" or 'importance' to the potential consequences of preserving a spiritual heritage site, constructing a power plant, or preserving wildlife. Again, the term "value" in this sense is context specific, and therefore, should be referred to as an attitude or preference within the language of psychology. Additionally, the importance of considering social and environmental sustainability in business model design is a process referred to as developing "shared value" [41]. Moreover, valuation in economic theory (i.e., monetary valuation) expresses a "preference" and not a Schwartz value. This review paper focuses on the socio-psychological terminology of values, which are broader constructs that guide behaviors, attitudes, and preferences across a person's life situations. Importantly, values are different from traits because there is an element of choice in deciding what is important [38].

The content of values has also been thoroughly explored from a sociocultural framework. For instance, in cross-cultural psychology, Hofstede made a significant contribution by operationalizing values at the cultural level in order to study the relative differences. Hofstede became interested in values after recognizing stable differences in workers' values (as opposed to attitudes). In this sense, values reflected desires (such as the ideal personality of one's boss), whereas attitudes reflected someone's understanding of an actual situation (one's attitude towards their actual boss) [72]. Hofstede's values are categorized as the desirable (general ideological statements) or the desired (importance attached to a job such as cooperation). In Hofstede's "cultural dimensions theory", values are at the core of what he calls the "mental programs" of collective cultures. His value theory is based on sixty different countries, where he found four distinct dimensions, namely: power distance, uncertainty avoidance, individualism, and masculinity [73]. He posits that these dimensions represent issues faced by all societies, and their relative differences refer to different learned society responses to these issues [72,74]. Importantly, Hofstede stresses that these dimensions are "ecologically derived", based on social systems and not individuals, and thus his findings cannot be reduced to explain/predict an individual's preferences [74].

Schwartz's published work in "Advances in Experimental Social Psychology", is recognized as a significant advancement in the socio-psychological understanding of values [37,68]. Here, Schwartz describes his comprehensive "Theory of Basic Human Values", which was based on the work of several scholars who preceded him, namely: Hofstede (described above); Allport, 1960 (who first attempted to describe values); and Rokeach, 1973 (who determined that the relative priority of values were important). Schwartz's theory describes 56 distinct values (expanded from Rokeach) that were empirically evaluated in 82 countries [37,51,68]. According to this theory, all values have the following six main features: (1) they are beliefs linked to emotion; (2) refer to desirable goals that motivate action; (3) they transcend situations; (4) serve as criteria and standards for decision-making (often unconsciously) (5) are hierarchical (relative importance contrary to norms and beliefs); and (6) their relative importance guides action [51]. There are ten basic values that are found across all cultures, which are distinguished in terms of their underlying motivations (see Table 1).

Table 1. Schwartz's 10 values and underlying motivations (adapted from Schwartz [51]).

Value	Underlying Motivation	Description
Power	Self-enhancement	Social status, prestige control, or dominance over people and resources
Achievement	Self-enhancement	Personal success and demonstration of competence according to social standards
Hedonism	Self-enhancement/openness to change	Pleasure sensuous gratification for oneself
Stimulation	Openness to change	Excitement novelty challenge
Self-direction	Openness to change	Independence agency in choosing and acting, creating, and exploring
Benevolence	Self-transcendence	Preserving and enhancing the welfare of "in-group" members
Universalism	Self-transcendence	Understanding, appreciation, tolerance, and protection for the welfare of all people and for nature, contrary to the 'in-group' focus of benevolence
Conformity and tradition	Conservation	In general, to subordinate the self to socially imposed expectations Self-restraint of actions that may upset or harm others Avoid violating social expectations or norms Respect, commitment, and acceptance of the one's culture or religion
Security	Conservation	Safety, harmony, and stability of society that one identifies with, of relationships and of self Security for the self and those with whom one identifies with (family or nation)

Schwartz postulates that these 10 basic values are found cross-culturally, as they relate to human needs both as living organisms (organismic needs) and as social beings (social beings). For example, the value of hedonism expresses an organismic need to experience pleasure, and cooperation expresses a social need for cooperation [51]. Importantly, as will be discussed later in Section 4.2, on value change, the way in which situational factors influence changes in value prioritization is influenced by which kind of need (material or social) the value addresses [38]. Moreover, these ten basic values are conceptualized by Schwartz on a circular continuum, where the more similar values are in terms of their underlying motivations, the closer they are positioned to each other [51] (p. 9).

3.3. Cross-Cultural Evidence for Schwartz's Theory of Values

Schwartz's theory of basic values is a well-developed and supported theory in the psychological study of human values. Each basic human value that Schwartz has characterized in this theory has been empirically confirmed to express the basic value they were postulated to express [75], and this type of study has been replicated many times over the years since Schwartz first presented his theory in 1992. Studies have assessed the theory with data from hundreds of samples and tens of thousands of participants in 82 countries around the world, using either the Schwartz Value Survey (SVS) or Portrait Value Questionnaire (PVQ) methods of measurement [51]. The samples included highly diverse geographic, cultural, linguistic, religious, age, gender, and occupational groups, with representative national samples from 37 countries [51,76–79]. These studies provide evidence that the oppositions of self-transcendence to self-enhancement values and of openness to change to conservation values are virtually universally present. Moreover, each of the ten basic values are distinguished in at least 90% of the samples. These findings show that people in most cultures respond to ten types of values distinctly, and that the broader value orientations captured by adjacent values are discriminated nearly universally. They strongly support the idea that human values form the motivational continuum postulated by the theory.

3.4. Schwartz's Value Theory Applied to IWRM: Determining Transcendental Values as a Desired Learning Outcome

In taking a closer look at the description of Schwartz's basic values in Table 1, we can identify the values most in line with IWRM principles and thus a potential learning target for SGs design. As discussed, the ultimate aim of IWRM is to pursue social equity and intergenerational equity, thus protecting the welfare of all human beings that depend on water resources now and in the future. This means that resources are to be managed in an equitable manner, throughout space (across socio-political boundaries) and across time (protecting future generations towards sustainability). Therefore, the basic value that most closely reflects the goals of IWRM is universalism, which is described as the "understanding, appreciation, tolerance, and protection for the welfare of all people and nature" (Schwartz 2012). Importantly, this is distinguished from benevolence, which concerns the welfare of only the "in-group" members, such as one's family or nationality.

We can also explore how Schwartz's values are relevant for current IWRM challenges and conflict. First, water management involves managing limited resources across political boundaries. Transboundary conflicts may involve a value conflict of power between nations, as well as benevolence (preserving the "in-group" of a nation's welfare at the expense of an "out-group"). According to Schwartz's model on the relationships between values, universalism and benevolence both share the underlying motivation of self-transcendence. Therefore, it is clear that these values conflict with power or achievement, whose underlying motivation is self-enhancement (opposite to self-transcendence). For instance, a community that decides to build a very prosperous industrial plant that is harmful to the surrounding ecosystem can be said to value achievement over universalism. However, it may be less obvious to identify the possible tensions between benevolence or universalism. Nonetheless, the types of dilemmas faced by water managers may involve different decisions, depending on the prioritization of benevolence and universalism. A clear example of this involves deciding whether or not to increase the water supply for irrigation to provide food in one's nation (benevolence), while compromising the future of sufficient water supply for another nation downstream. Second, conflict in water management may also occur between water uses, which may involve conflicting values between power (dominance and control over water) versus security (preserving ecosystem health). On the other hand, the values of power and security in water management may be completely aligned. For instance, power over water sources, such as building a dam, may provide the necessary water for irrigation, and thus "food security" for a nation. Such conflict achievement may be relevant for industries that utilize water resources and are strongly motivated to achieve economic success and status. Third, a key IWRM challenge involves uncertainty, which is addressed in adaptive management

strategies. Adaptive management strategies involve continuous evaluation and change, which may involve prioritizing the value of “openness to change” over “conservation”.

Evidently, there are many potential value conflicts involved in water management challenges. Overall, it seems that promoting universalism (over conflicting values of power and achievement) is the most relevant for the IWRM goals and is transferrable across different situations. Moreover, water is a common resource that is depleted or negatively impacted if each person rationally pursues their own self-interest without regard for the collective (the so-called “tragedy of the commons” [49]. In this regard, by virtue of managing water, IWRM conflicts with the underlying motivation of self-enhancement, which further argues for IWRM to prioritize its opposing motivation—self-transcendence. However, with the recognition that there may be complex dilemmas between benevolence and universalism in the water management context, the discussion will refer to promoting “transcendental” values as a learning outcome, referring the underlying motivation of both benevolence and universalism.

3.5. *Evolutionary Approaches from Behavioral Economics to Cognitive Anthropology*

A general consensus from cognitive science to behavioral economics similarly casts ‘values’ as relatively stable pre-reflective processes that guide individual decision-making and action. In the so-called two-systems account of reasoning, spearheaded by Kahneman and Tversky, human thinking is characterized by evolutionarily older “fast”, automatic, intuitive processes (the so-called System 1), and evolutionary younger, “slow”, deliberate reasoning modulated by language (the so-called System 2) [80–82]. On this account, human motivations and behavior are primarily modulated by automatic System 1 mechanisms, such as heuristics and biases like base-rate neglect (extrapolating from immediately salient cues without considering context), the availability heuristics or frequency bias (forming a judgment based on what comes to mind easily and assumptions that are culturally widespread), the confirmation bias (attending to select cues to confirm what one already believes), or a variety of emotionally-driven processes [80,81]. Rational utility maximization, on these views, can only be derived through effortful, often counter-intuitive reasoning.

Debates are ongoing regarding the extent to which humans engage in rational decision-making, as well as the role of culture and cultural differences in facilitating this process. In psychologist Jonathan Haidt’s classical experiments on moral intuitions, for example, subjects in a variety of national and socioeconomic samples were shown to reach decisions on what is right or wrong that were invariably consistent with those of their respective groups [83]. In what came to be known as the “moral dumbfounding” paradigm, subjects consistently followed their gut-feelings to reach a moral position, offered post hoc rationalizations to justify their feelings as just right or wrong, and were unable to explain their motives in more detail. Cultural psychologists and cognitive anthropologists have adopted this model to describe the universal process through which people outsource value judgments (moral and otherwise) to intuitions, primed by culturally-specific values [84]. In Haidt’s experiments, college-educated students were significantly more likely than groups from other socioeconomic status to voice utilitarian values, (in Haidt’s interpretation) simply because utilitarian values are commonplace and normative among western educated people. In a similar vein, experiments in developmental psychology have shown that children are intrinsically motivated to enforce the norms they can intuit from their social groups [85].

This renewed attention to culture in cognitive science has prompted a re-evaluation of rational decision-making and game-theoretic models that has shown that compared to apes, humans across cultures typically favor obedience to group norms, and group fitness to individual maximization [60,86–88]. In more recent accounts, humans have been argued not to possess any rational “reasoning” abilities at all, but rather to display the selective capacity to make intuitive inferences to question other people’s motives in communicative and justificatory situations that involve arguments with others [89]. Taken together, these different “cultural learning” approaches suggest that values are best studied and experimentally manipulated by focusing on the social context in which they arise and are enacted—that is, by targeting the universal evolved biases through which humans outsource their preferences

to what they expect relevant agents to also expect of the world. This might be best achieved by conceptualizing cultural groups, as people united by shared expectations that selectively pattern the salience and valence of what one attends to in the world (i.e., regimes of attention in processes of niche construction) [90,91].

The prestige bias [60,86] and in-group or out-group biases (see Section 4.3.3 for further explanation) are good candidate targets for this process. In this model, people can be motivated to shift their value systems (e.g., toward ecologically sustainable practices) by looking up to prestigious agents and cultural forms (e.g., celebrities, fashionable musical genres, and leaders) from their own group. Marking target behaviors with prestige through credibility enhancement displays (CREDs) [60,92], can help direct attention toward features of the world (e.g., locally produced foods), behaviors, and intended outcomes (e.g., recycling; attending community meetings) that will become positively valued through their association with high-status agents. Competing with a perceived out-group with an opposite set of values (often one in which the valence equation is simply reversed – e.g., recycling is bad) will also help reinforce.

4. Mechanisms and Constraints in “Learning” Transcendental Values

Figure 3 below provides an overview of the remaining discussion that focuses on determining the desired learning outcome for IWRM within the field of social psychology, as well as the structure of the subsequent sections of this review paper.

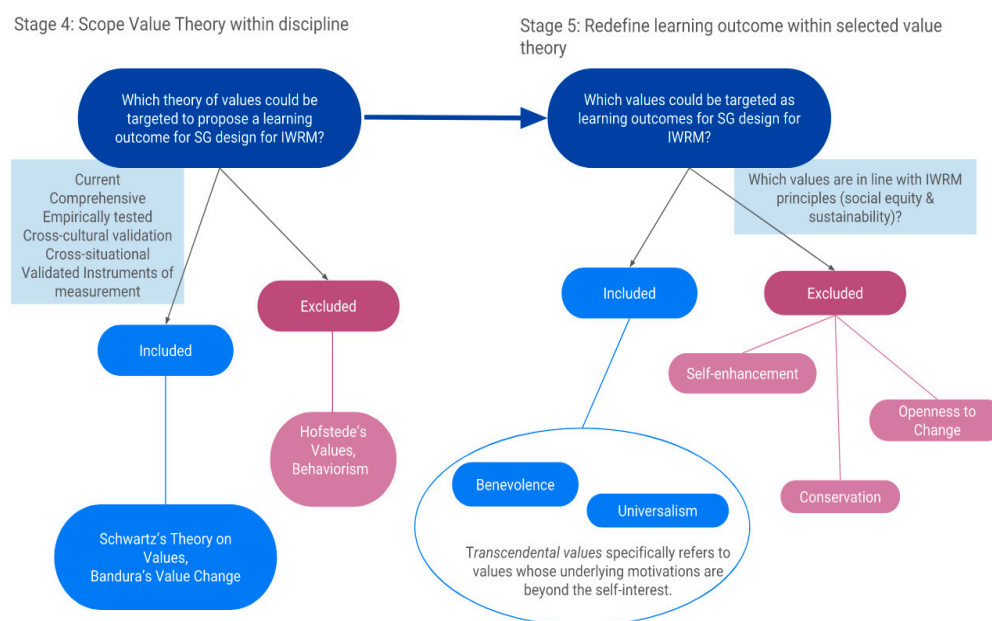


Figure 3. Determining the desired learning outcome for IWRM within the field of social psychology.

In order to explore the potential learning mechanisms behind promoting transcendental values in SGs play for water management stakeholders, it is important to distinguish between the mechanisms of value change and value-congruent behavior. Value change refers to a change in the prioritization of values, for instance, changing the prioritization of self-enhancing values (achievement) compared to self-transcendence values (benevolence) [68]. Value-congruent behavior refers to making decisions or actions that are in line with one's values. Notably, value incongruent behaviors and decisions are possible, as persons may not always perceive how a decision or behavior conflicts with their value prioritization (limit to value perception). Additionally, other psychological factors (such as norms) may dominate influence on behaviors [68]. For instance, time-constraints could cause one to override their benevolent value prioritization, leading persons to consciously avoid helping a person in need

when running late for an appointment [68]. Therefore, the normative learning outcomes for water management decision-making can be categorized in the following way: (1) values are being applied (activated) in decision-making (2) and transcendental values are prioritized.

4.1. Value-Perception and Value Congruent Behavior

To help ensure value-congruent action, people first need to notice and understand how their values are implicated in a situation. Otherwise, other psychological processes or constructs may dominate decision-making behaviors. Indeed, values' prediction of attitudes or behavior is significantly improved when people explicitly view the situation as being connected to their values [68]. Maio has explored this process, making the distinction between typical and atypical value instantiations [68] (p. 29). A value instantiation refers to a concrete application of a value. Typical value instantiations refer to situations where the relevance of a value is typically /commonly perceived, such as the value of social equality in the context of two persons of different races applying for a job. In contrast, an atypical value instantiation refers to situations where a value is less commonly perceived, such as left and right-handed people's job applicants. In this example, both typical and atypical instantiations involve the same value, however, someone who prioritizes social equity may not notice the value relevance in the atypical instantiation. According to Maio, prior instantiations of typical value applications will affect the process of value application for other typical scenarios by increasing one's ability to perceive value in similar situations [68].

The theory of atypical and typical value instantiation could be applied to SGs for water management and potentially represent long-term learning outcomes. For instance, the "rules of the game" could demand explicit identification or discussion of values involved in water conflict scenarios that represent typical or atypical value instantiations. Through this process, game players could potentially learn to more readily identify the values at play in different water management situations. Consequently, values could potentially be activated in decision-making beyond the game context, if the scenarios encountered in the game are similar to those in real life. Although this does not guarantee decision-making based on transcendental values, it potentially leads to more value-congruent decision-making. Interestingly, explicit value deliberation has recently been explored as a potential for developing shared values in ecosystem services [93]. Also, social learning processes involve critical self-reflection on one's perspectives and goals, and thus, could include a reflection of one's values in the group settings involved in water management decisions [12,61,94].

Interestingly, the theory of atypical versus typical instantiation helps clarify the difference in value-based decision making in management literature versus social psychological theory of values. For instance, an environmental scientist and spiritual leader, based on their experiences, may be said to value (management literature) certain outcomes of a water management decision over others (such as preserving heritage site versus preserving wildlife). From the domain of psychology, both the scientist and the spiritual leader may share the same values (equally prioritizing transcendence over self-interest), even if they have different preferences over the two possible outcomes. The theory of typical value instantiation may explain why the environmentalist may more easily identify how self-transcendence is implicated in preserving the wildlife, while the leader may more easily identify how self-transcendence is implicated in preserving the heritage site.

4.2. Value Change

From the perspective of social psychology, values are relatively stable psychological constructs as they are integral components of our self-concepts, maintained by emotion and past experiences [38,69,95]. Nonetheless, values have been shown to change both on an individual and societal level in certain circumstances. For instance, a change in the socio-environment that enables or suppresses one's opportunity to express a value may cause value change in order to adapt to the new circumstance. Studies on both MBA and law students, for example, found a decrease in students' mean prioritization of benevolent values with an increase in achievement values, after being exposed to the high-achieving

environment of their program [38,51,96]. Also, a change from rural to urban environments was shown to foster individualistic (self-enhancing) values in Japanese immigrants [97]. Evidently, values can be suppressed if individuals cannot pursue them, based on the constraints imposed by their culture or environment.

Importantly, the direction of value change may depend on the underlying motivation being suppressed or expressed. For instance, suppressing self-enhancing values that relate to human needs lower on Maslow's hierarchy (materialism and security) may cause an increase in their prioritization, whereas transcendental values are enhanced with the opportunity to express them [38,51,98]. Second, certain values can be prioritized based on primers, such as how or what language is used in discourse. For example, using "I" versus "we" in storytelling may affect the subsequent value prioritization of collective (transcendental) values. Also, the English language acts as a primer of individualistic values compared to Chinese in SVS surveys [38]. Third, emotional triggers have been shown to lead to the prioritization of certain values. For instance, anxiety provokes self-enhancement whereas non-anxious emotions may lead to transcendental values [38,96]. Fourth, as values are generally supported by affect (unconscious truisms) rather than strong cognitive rationalization, conscious reflection and reasoning about values may cause values to change [96].

Bardi [96] was one of the first to focus on the mechanisms behind long-term value change on the individual level (referred to as intra-individual value change) using Schwartz's framework. According to her work, the understanding of value change could be categorized in the following way: individual versus group value change, systemic value change, short-term versus long-term change, and automatic versus effortful change mechanisms.

Firstly, Bardi studied the changes in terms of how individuals ranked the importance of their values (rank order change). This is distinct from the study on how values change in a group, where researchers look at the changes in the mean importance of a value of a population over a certain period of time (mean level change). Mean value changes were the primary focus of studying value change from other disciplines such as sociology and political science [38,96]. The mean level changes observed in groups and cultures across time are thought to be the result of shared experiences and changing environments, such as economic development, educational changes, and societal changes [96]. For instance, Inglehart's book, "The Silent Revolution", discusses a mean value change due to the post-modern western culture, whose values are moving away from materialism and self-enhancement, and moving towards transcendence and self-direction [98]. On the other hand, rank order value changes are observed when an individual's values change based on their distinct personal experiences.

Secondly, Bardi proposed that individual values change in a systematic way, according to Schwartz circular model, whereby, "compatible values change in the same direction and conflicting values change in opposite directions" [96]. Thus, an individual change in ranking one value will predictably affect the whole system of values in a way that is consistent with Schwartz's circular model. For example, an increase in achievement will also cause an increase in power, as both of these values share the underlying motivation of self-enhancement. Bardi supported this proposition in four longitudinal studies of rank value change in individuals [38].

Thirdly, Bardi looked into the possible mechanisms that transition from short-term to long-term changes in values. According to her model, more permanent changes in one's values result from a change in one's schema (mental model), after repeated environmental cues. For instance, one's values can change permanently following a change in one's life situation, such as becoming a parent or moving to a new environment with a different culture [38].

Fourthly, the mechanisms of value change can be automatic or effortful. The automatic processes of value change are facilitated by unconscious cues, which can be the result of primers (clues to alternate schemas), adaptation (to new environment or life situation), or identification (with role model, group, or peer). Interestingly, the value change resulting from adaptation relates back to behaviorist reinforcement theories, where a new social environment can frustrate one's values and consistently reward an alternate value. For example, moving to an individualistic culture (where positive rewards

are associated with self-enhancing behaviors) can result in decreasing collectivist values. On the other hand, effortful changes in values require conscious cognitive reflection and re-evaluation, which can also occur through adaptation and identification. Additionally, effortful changes in values can result from attempts to maintain consistency in one's positive self-concept. For instance, subjects that receive negative feedback by peers after filling an SVS, (such as being characterized as selfish), have been shown to cause a subsequent re-prioritization of values. This relates back to the theory of cognitive dissonance, whereby individuals are motivated to maintain consistent self-concepts [99]. Finally, one can change values through effortful mechanism if they are convinced by direct persuasion. However, direct persuasion (such as through the media or education) is a particularly tricky route towards value change, as they are central to one's self-concept, and direct attacks to one's values often trigger defense mechanisms [38].

4.3. Some Social Psychological Limitations to "Learning" Transcendental Values

In order to manage the expectations of potential SGs to result in transformative learning outcomes, it is important to consider key challenges to influencing value change and value-congruent behaviors. The challenges described here are thought to be important in the context of water management, which involve stakeholders with individual differences that have both personal and group identities. However, it is recognized that there are many more challenges from the psychological framework that could be discussed. Here, we briefly overview the psychological mechanisms to resist change, individual differences in capacity to embrace transcendental values, and challenges of cooperation between members that hold different group identities.

4.3.1. Resistance to Changing Self-Concept

On an individual level, psychological defense mechanisms resist value change. Therefore, direct messages that try to persuade a change in values are not likely to have an effect. In fact, resistance to change attitudes from direct persuasion have been shown, where attitudes are less central to self-concepts than values [38]. Also, Maio, 2010, showed that people did not change values from cognitive elaboration if they were aware in advance of attempts of value change, and thus prepared rationalizations to their values [38,68].

4.3.2. Individual Differences in Capacity to Embrace Transcendental Values

There may be individual differences in the capacity to truly embrace transcendental values. Firstly, from the perspective of behaviorism, there may be biological differences in one's ability to experience reward, based on pro-social behaviors [39] (p. 277). For instance, neurobiological markers are associated with charitable action, and persons that reciprocated in a "trust game" were found to have significantly higher levels of oxytocin (hormone implicated in social bonds) in their blood [39] (p. 278). Secondly, from a psychopathological perspective, there may be individual differences in capacity for both cognitive perspective taking (theory of mind, ToM) and affective concern for others (affective empathy, AE). Interestingly, research carried out on autistic individuals (low ToM and normal AE) and psychopaths (high ToM and low AE), and persons with Down's Syndrome (high ToM and AE, and low IQ) have revealed that these abilities may operate independently from one another [100–102]. Therefore, training on perspective taking, (such as through role play) has shown that an enhanced cognitive ability to understand others' perspectives may not necessarily result in increased affective concern (AE) in all individuals equally (and thus not likely enhance transcendental values). Moreover, training on perspective taking for persons with a limited capacity for affective empathy has also been shown to result in a greater manipulative power [102]. Although some studies show that perspective taking can induce concern for others and the environment [41], it is important to recognize these potential limitations. Thirdly, there may be individual differences in a person's ability to disengage from their moral principles and values. Moral agency requires self-regulatory mechanisms in order to result in moral action, and persons may differ in their ability to self-regulate (self-sanction) [50].

Also, there are certain factors that can cause moral disengagement, namely: masking an immoral act as serving a moral purpose, diffusing or displacing of responsibility, weakening their perceived control upon an outcome, and dehumanizing a potential victim. Not surprisingly, persons that are prone to morally disengage are less likely to engage in prosocial behavior [50].

4.3.3. Intergroup Conflict

Intergroup conflict may be an important potential barrier to learning or fostering transcendental values during SG play. Conflict between members of a group can be understood from the study of intergroup relations, which looks at the conditions where individual behavior is made based on their membership to a group and attempts to explain their complex behavior, defined by Sherif [103] as “whenever individuals belonging to one group interact, collectively or individually, with another group, in terms of their group identification, we have an instance of intergroup behavior” [104]. The theory is characterized by three main principles, intergroup accentuation (accentuating in-group similarities and out-group differences), in-group favoritism (favoring in-group members, such as positive evaluations or allocation of resources), and social competition (competing for status/distinctiveness in social hierarchy) [105]. When the intergroup schema is activated, these three principles come into play. Notably, even without prior membership to a group, an arbitrary categorization of group members induced by an experimental setting (as sorting research subjects into teams of red and blue T-shirts) can motivate individuals to behave on the basis of their group membership rather than on individual or interpersonal relations [104,105]. As an intergroup schema can be activated arbitrarily in experimental settings, it is likely to be activated during game play if players are put into teams.

Intergroup conflict is a key player in the complexity between the pursuit of benevolence (towards ‘in-group’) versus universalism (for all), and is seen as one of the reasons benevolence (i.e., between in-group members) is prioritized over universalism in many cases [51]. An example of this in the context of IWRM could be someone benevolently investing their resources to build a dam to increase water supply for a community that is facing water-scarcity (in-group) at the expense of the downstream consequences to another community in the future (out-group), which also can also include species health within the ecosystem (such as fish migration). Moreover, conflict between group members is extremely relevant in the context of natural resource management, where the stakeholders involved are likely belong to well-defined social groups with histories of conflict (especially in transboundary water management between conflicting nations). For these reasons, a more in-depth discussion on intergroup conflict as a barrier is discussed below.

Empirical studies in intergroup relations have looked into factors that facilitate or constrain the reduction of conflict between group members. Firstly, making different groups cooperate rather than compete results in less discrimination and conflict between them. However, the effectiveness of a cooperative context (i.e., introducing subordinate goal) in reducing conflict depends on the salience of the existing group identities [105]. Secondly, personal contact with an out-group member may reduce conflict and prejudice. However, this requires that attention is drawn to the individual’s personal characteristics rather than their group identity [105] (p. 293). Thirdly, the need for positive social identity (in social identity theory) suggests complementary roles towards a common goal for a positive interpersonal contact experience between members of an out-group. Complementary roles in achieving a goal allow for individuals to preserve their positive distinctiveness (social competition) while cooperating. This process is particularly interesting in the water management context, as it does not call for changing one’s understanding of their group membership, but alters the negative understanding of interdependence between the in-group and out-group [105] (p. 29).

In a water management context, this would involve different stakeholders (i.e., industry, environmentalists, and government) to preserve their distinct group identity (which can be related to their professional background), but have a positive experience in cooperating, by engaging in complementary roles towards achieving a sustainability goal. If such an experience in a game setting could be salient/positive enough, it may lead to permanent changes in perceptions about the

negative interdependence between them. In this way, game play could potentially have a positive long-term effect towards cooperation between stakeholders, without compromising or threatening their self-concepts and social identities. However, there are concerns for stable change in any of the above three processes mentioned, as they are deemed unstable in the context of optimal distinctiveness theory [105].

5. Recommendations for SGs Design

A recent study by Aubert et al. [20] provides an in-depth review of 43 SGs on water-related issues, and categorizes these games according to the level of technology used (i.e., from no low-tech to fully immersive high-tech) and the degree of verisimilitude (i.e., from modeling complex reality, using scientific models and real-world data to not using any scientific models or real-world data). These 43 serious games span purposes ranging from the following: (a) SGs that broadcast a message to teach and raise awareness on water related issues; (b) SGs that present direct or indirect exchanges of information (e.g., data, knowledge and worldviews); and (c) to SGs that reproduce a real-world situation with accurate reality, to provide a training experience for professionals. Direct (i.e., two-sided information) exchange games involve simulation games, often played in a workshop format with a scientific game facilitator, that aim to structure problems or develop scenarios while informing a scientific model, as well as allowing participants to develop an understanding of other players' perspectives [25,27]. Indirect exchange games allow for learning or awareness raising as well as data collection. The focus of this study is on what Aubert et al. [20] refer to as "hybrid games", which combine role playing games with computer simulations, and allow players to experience the impact of their decisions or actions over time, while developing an understanding of the complex interactions of social, environmental, and economic factors. These types of games enhance discussion and learning among players, thus enhancing social learning, and generally require a facilitator or game leader to introduce the game context and rules, encourage collaboration, and facilitate a debriefing phase [19,106].

Based on the psychological mechanisms and constraints of value change discussed in this paper, there are several factors that could be incorporated into the design of these "hybrid" SGs for water management stakeholders. Such design elements could potentially lead to the improved application of social equity and sustainability in IWRM decision-making through the enhancement of transcendental values. Of course, there is considerable research that remains to be conducted in terms of its potential effectiveness. The recommendations made here are preliminary, yet are thought to warrant further exploration and research. The concluding remarks will be organized by relating the key features of values from social psychology, and then relating them to SGs design. These relationships are discussed in Table 2 (SGs design opportunities) and Table 3 (SGs game design constraints).

Table 2. Serious games (SGs) design opportunities for “learning” transcendental values.

Key Features of Social Psychology	SGs Design Opportunities
Values are hierarchical in nature It is the relative prioritization of values to one another that is important, not values in isolation.	SGs design could incorporate scenarios of conflicting values where players are forced to prioritize their values in decision-making. This is possible in the water management context that often involves conflict of values (such as economic efficiency versus intergenerational equity).
Values change as system, not in isolation Schwartz's circular model is an accurate model of the mental representations of relationships between compatibilities and conflicts between different values.	If the game fosters self-enhancing values, such as achievement, then self-transcendental values, such as cooperation, will be reduced. SGs design can influence values not targeted in the design. SGs design needs to consider all values at play in game design if it aims to target one value. This is especially interesting in the context of game play that often involves achievement objectives for players, whereby the ‘rules of the game’ could demand cooperation or competition in order to succeed. Also, game design could involve threats to one's security, which could conflict with cooperation.
Values are primarily based on emotion (a) Emotions are the primary source of information for consensually important values and play a stronger role than past-behavior and beliefs. (b) There are different emotional consequences when violating one's peripheral versus central values. Violating peripheral values results in anxiety emotions, whereas violating central values results in dejection emotions (sadness). (c) Anxiety-inducing emotions can trigger self-enhancement values.	(a) As values are emotion-based, SGs play that involves values should be emotionally salient. Also, as people often hold onto values without having supported them with cognitive reasoning, having players reason about their values may lead to value change. (b) Post-game surveys on affect can give insight to whether values were violated and whether they were central or peripheral to one's self-concept. (c) Beyond the game context, real-life consequences to one's safety and security may cause anxiety-related emotions that potentially lead to self-enhancement values. SGs designers could consider this as a potential constraint to learning transcendental values. SGs designers could also consider which emotions are involved in game play and test players' level of anxiety during the iterative design process.
Values are influenced by culture and cultural differences (a) Individual values are invariably consistent with those of their respective social groups. (b) Humans across cultures typically favor obedience to group norms and group fitness to individual maximization. (c) Values are best studied and experimentally manipulated by focusing on the social context in which they arise and are enacted.	To foster self-transcendental values, SGs can be designed to target the universal evolved biases (e.g., prestige bias, and in-group or out-group biases) through which individuals and social groups outsource their preferences by conceptualizing cultural groups as people united by shared expectations. Competing with a perceived out-group with an opposite set of values will also help reinforce a shift in value systems towards, for example, ecologically sustainable practices.
Values are abstract and do not always influence decisions or behavior (even though they guide overall behavior and decision-making across situations)	SGs design could help bridge the value–action gap by requiring the detection of value relevant features in a conflict and requiring cognitive value-elaboration in water management decisions.
Values can be learned from identification	SGs could consider value elaboration in group settings for the possibility of members to identify with role models that hold cooperative values. However, it would be difficult to ensure that positive role models are present and identified with. Alternatively, virtual role models could be introduced, however, it is unclear how virtual role models affect identification.
Values can be learned through cognitive reasoning	There is the possibility for SGs to design a space for reflection and a cognitive elaboration of reasoning behind values, which may lead to a change in values (because values are often experienced emotionally without cognitive reflection). Such a process also leads to an increased perception of how values are involved in water management decisions. This requires time and space for reflection on values involved in decision-making. To design games according to theories on values, time for reflection is ultimately necessary.
Available empirical tools for assessing value change in groups and individuals (self-report surveys)	During an iterative design process, SGs could monitor learning and values with tools available, such as the Schwartz's Value Survey (SVS). SGs designers would have to decide whether to test mean changes in groups, or rank order changes in individuals, and long-term versus short term value changes. SGs designers could develop a tool to test value change through actual decisions made during game play, as decisions reflect value prioritization. This likely would contribute both to the game design as well as the psychological understanding of values in decision-making behavior.

Table 3. Key constraints to consider in SGs design for developing transcendental values.

Key Features of Social Psychology	SGs Design Constraints
Values are central to self-concept and resist direct persuasion	SGs design should not demand value change or involve a facilitator that directly tries to persuade players to change their values. However, in group settings, direct persuasion from other players may occur. This represents a potential constraint to learning “transcendental” values.
Values compete with other psychological factors in influencing decisions and behaviors	SGs designers should manage expectations of learning outcomes as human behavior is complex. If SGs game design demands explicit value-congruent behavior during play, this may not always be translated outside the game context because other psychological factors may dominate. SGs designers could also consider other psychological factors at play that may compete with values in terms of decisions-making behaviors of players and explore ways to mitigate those factors.
Intergroup conflict (intergroup conflict is a considerable barrier to cooperation in water management issues and also arises when arbitrary groups are made)	SGs could consider ways to mitigate intergroup conflict in game play. However, the psychological mechanisms to mitigate intergroup conflict are well beyond the scope of this paper. Some interesting possibilities based on brief discussion are (1) increase the salience of individual versus group identity (which would likely require in person contact); and (2) the application of ‘optimal distinctiveness theory’ by assigning distinct roles/expertise towards a common goal. Importantly, real-life water management likely involves salient intergroup conflict. SGs design could alternatively decide to emphasize intergroup conflict, by making salient clues on the group identity of different stakeholders, or assigning arbitrary groups. In this way, SGs play could give insight to intergroup dynamics in real life water management problems and potentially offer insight into appropriate policy design to address this issue.
Individual differences in capacity for moral engagement (affective empathy and cognitive perspective taking are independent abilities in humans)	Perspective taking and role switching could induce cooperative values by only in individuals with capacity of affective empathy. Doing so for those who are incapable will only make them more manipulative. Again, this constraint should manage expectations of SGs design outcomes in teaching transcendental values. Further study could identify those with more or less capacity for empathy in managerial or decision-making roles.
Permanent value change correlates with high impact life events	The ‘non-real’ of a game may not be interpreted as an impactful event for game players. As game play is not a ‘real life’ event, this makes it difficult to be impactful for a long-term change of values. SGs could work around this constraint by (1) focusing on enhancing value perception water management decision-making; and (2) focusing on potential mechanisms of value change by delivering consistent cues through repeated game play and social interactions.

The list of research publications where SGs have been used and reviewed for IWRM is considerable and fast growing (e.g., [15,20,21,23,25,106]). A few studies stand out as providing experimental evidence of the ability and means through which SGs may facilitate behavioral changes. Vegt et al. [107], for example, demonstrate how, by changing the rules of a game, the players can be directed towards either competitive or collaborative behavior. Another example is a study by Kampf and Stolerio [108], which highlights the value of serious games in enhancing players’ empathy for the perspectives of others, encouraging players to critically reflect on their own position, and provide a forum where parties can develop a relationship by interacting in a safe environment. Tipton et al. [109] emphasize that learning happens during a serious game, while players observe the impacts of their decisions and receive feedback on their actions, but that a debriefing phase after the game is essential as a way to draw lessons and critically reflect on the game process and outcomes.

Despite a growing interest in serious games for water resources management, novel approaches towards serious game design from a sociological or psychological are still lacking [110]. Linehan et al. [110] stress the importance of better understanding the spectrum of relevant social and psychological processes acting on both the designer as well as a players of serious games. They state that to increase the potential benefits of SGs, a deeper understanding is required of the processes through which players are incentivized to behave in a productive and sustainable manner, answering questions about how to measure, understand, predict, and guide people’s behavior.

Overall, several important recommendations can be derived from exploring psychological perspectives and the potential of value change for IWRM stakeholders through SGs play, namely:

- SGs design should target values systematically, as individual changes in values also result in changing non-targeted values.
- SGs design should involve many value conflicts that are faced in real life water management decisions, so that players are not only forced to prioritize values, but also learn to recognize how their values are involved across many water management situations.
- As values are often supported by emotion and water management decisions can be complex, having players engage in the conscious reasoning behind the values involved in decisions represent important potential learning mechanisms. Reasoning about values has been shown to cause values to change, and this could potentially be incorporated in SGs play. Importantly, this requires time for reflection about one's values, where time for reflection has already been recognized as a constraint in IWRM games [11]. Notably, a similar concept is being applied in SGs for clinical medical ethics, involving the conscious deliberation of deontological ethics (ethics based on principles rather than consequences) in clinical decision-making, to foster virtuous medical professionals [111] (p. 99).
- Intergroup conflict in water management represents an important barrier to value change, both within and beyond the game context. Intergroup conflict is a complex phenomenon between in-groups and out-groups, and SGs can address this issue either by enhancing group conflict to explore their dynamics, or by mitigating conflict to promote cooperation between out-groups. Moreover, the relationship between intergroup conflict and universal versus benevolent value prioritization in water management decisions warrants further study. Water management decisions may involve conflict between universal and benevolent values, even though they share the underlying motivation of self-transcendence. Such relationships can potentially be explored through SGs play. Notably, in order to explore such dynamics, it may be more interesting to have team players that can compete or collaborate in person (rather than interact online or with computer models).
- Whether or not players' values change (in the short or long-term) can be tested using SVS during the iterative SGs design process. Values are primarily based on emotion, and individual differences in the capacity for affective empathy constrain value change for certain individuals. In addition to considering how values are involved when designing SGs, Schwartz' value survey can be used to examine the prioritization of values for participants engaged in existing water related serious games. Interestingly, the researchers involved in this paper have been administering the SVS survey to subjects both before and after participating in a number of game simulation events. The results and insights from these events and the resulting surveys will be used to determine whether playing the SGs had any effect on participants' values.

All in all, this discussion attempts to address a significant challenge for SGs design, and whether it can have an impact on the underlying belief systems of water management stakeholders. The importance of this challenge is illustrated by some of the responses of the actual game players in this context. For instance, in her exploration of SGs for marine spatial planning and water management, Zhou found the following responses from interviews (interviewee No. 18), "Experience shows that it is very hard to change players' belief by playing games...they don't really relate the game to their real world problems or seriousness" [7] (p. 105), and (interviewee No. 20) "Policymakers look for excuses not to learn from the game. Gaming is not the thing to change the behaviors of individuals" [7] (p. 10). Despite this obvious challenge, the current understanding in psychology behind changing values provides insight into the mechanisms that can be incorporated into SGs design. Moreover, the empirical testing of values and value change, followed by improving SG design, could move beyond addressing SGs design challenges and provide some insight into important psychological phenomena. Further, studies for both psychology and SGs design could look into

the impact of reflecting on values in groups compared to interaction with a computer or online game. Also, individual differences in the ability to embrace transcendental values could be studied. Finally, more effort could look into how to effectively communicate about values in groups or other mediums (such as ICT), and how SGs could provide a space for formulating policies aligned with values in complex water management decisions or dilemmas.

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