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# Environmental motivation as a complex dynamic system

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**Abstract**
Environmental Motivation (EM) is conceptualized as a process of moral motivation, and examined from the perspectives of complex dynamic systems and self-determination theory. EM is a complex dynamic system that develops in multiple time scales. Relationships between multiple motivations constitute the activity of this system, out of which environmental behaviors (judgments and actions) emerge. As a dynamic system, EM displays substantial interpersonal differences, as well as intrapersonal variation in terms of differential strengths of multiple motivations over time and across contexts. The operation and development of this system is both individualized and contextualized, as EM is an open system in close connection with dynamically changing contexts. Support for autonomy, competence and relatedness is a property of dynamic contexts, which influence the development of EM in terms of increased integration and internalization. The development of environmental identity and sense of duty are central for the development of EM. A model for short-term and long-term development of EM is proposed. Implications for understanding the complexity of environmental behavior and facilitating EM are discussed.

**Keywords** Environmental motivation · Environmental behavior · Moral motivation · Dynamic systems

This paper presents an approach to environmental motivation (EM) from the perspectives of complex dynamic systems (CDS) and self-determination theory (SDT). We present and examine EM as a domain of moral motivation. The development of EM as a moral phenomenon involves the development of care for the environment, as a motivational process. The motivation for self-interest is experienced in combination with care for the environment. Relationships between and regulation of care and self-interest contribute to the experience and development of EM. This process involves the development of environmental duty in connection with environmental identity. The aim of the present paper is to explicate the new model of EM, including the complexity and development of EM and its connections to proenvironmental behaviors and basic psychological needs.

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EM is a complex dynamic system that develops in an iterative and relational process over short-term and long-term time scales, in close connection with dynamic contexts, which themselves change over time. Contextual factors such as support for the satisfaction of basic psychological needs (Deci & Ryan, 2000) influence the dynamic system of environmental motivation out of which environmental judgments and actions emerge. Within the individual's experience over time, one state of EM serves as a building block for its next state.

The rate of development varies across individuals. The development of EM is individualized, and subject to the characteristics of complex dynamic systems such as nonlinearity, multi-causality, iterative (recursive) change, and emergence of new experiences through spontaneous relationships between system components (self-organization), and interconnectedness between multiple time scales (Lewis, 2000, 2002, 2005; Thelen & Smith, 1994, 2006; van Geert, 1993, 2009a). The proposed approach to EM is based on an energetic view of the human mind, including a motivational view of learning and cognition (Kaplan, 2017, 2019; Plass & Kaplan, 2016).

EM is a complex phenomenon, subject to development in short-term and long-term time scales. This developmental

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process takes shape through both self-organization and self-regulation. As a distinction, self-organization can be seen as primarily a bottom-up process, and self-regulation can be considered as largely—though not exclusively—a top-down process. In the present model, the specific components of EM that are subject to self-organization and self-regulation are the motivations of self-interest and environmental care. The spontaneous relationships they form in the dynamic system of EM constitute the process of self-organization. Intentional direction and management of these two motivations constitute the process of self-regulation.

EM can be seen as a system of competencies that are motivational. This view resonates with Rychen and Salganik's (2003) holistic conceptualization of competence as "the ability to successfully meet complex demands in a particular context through the mobilization of psychological prerequisites (including both cognitive and noncognitive aspects)" (p. 43). This process "requires the mobilization of social and behavioral components such as motivation, emotions, and values" (Rychen & Salganik, 2003, p. 45). Consistently, "cognitive and affective dispositions" as well as "behavioral strategies" (Hollweg et al., 2011, pp. 1–3) are important to EM. Similarly, Hunter and Jordan (2022) emphasized identity and related dispositions toward environmental systems, as well as behavior while engaging with those systems. Consistently, there is evidence that environmental identity is associated with environmental action (Kempton & Holland, 2003).

Roth (1992) proposed four strands for environmental literacy; (1) knowledge, (2) skills, (3) affect and (4) behavior (p. 18). Among the four strands, affect includes environmental sensitivity, attitudes and values; and behavior includes personal investment and responsibility, and active involvement (see also, Hollweg et al., 2011). From the dynamic motivational and energetic perspective of the present CDS perspective, each of these four strands require and utilize the biopsychological energy of the individual, who is subject to limited resource conditions. According to the CDS perspective, the components of a given dynamic system form competitive and cooperative relationships under limited resources (van Geert, 1993). It follows that according to the present formulation of EM from a complex dynamic systems (CDS) perspective, these multiple strands are likely to cooperate and compete in the development of EM. Their competition and cooperation contribute to the development of EM over time in the experience of each individual.

For example, it is possible that an individual's affect (third strand) (including environmental sensitivity) is in conflict and not aligned with habits of behavior (fourth strand). This state represents a competitive relationship between two strands. Such a clash between affect and behavior regarding environment can be overcome over time through increased knowledge and skill (development of the first two strands), and increased self-regulation toward the cooperation of affect and behavior. In that process, the individual may modify behaviors to become more aligned with his environmental sensitivity (part of the affect strand). In this developmental process, the four strands develop both on their own and in close connections with each other. Thus, applying Werner's (1957) orthogenetic principle, the development of EM is toward increased integration and differentiation of knowledge, skills, affect and behavior for the protection and sustainability of environment.

In this process, the regulation and coordination of the motivation of self-interest in the service of the motivation of care is particularly important. In other words, the environmental motivation of care can develop in such a manner to employ self-interest in their service. This involves an identification with environmental care, moving beyond total identification with personal needs. According to self-determination theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2000), this experience corresponds to *identified regulation* (based on what is personally important), a form of extrinsic motivation that is highly more internalized and autonomous than *external regulation* (based on rewards and punishment) and *introjected regulation* (based on feelings of approval and guilt). As EM becomes more autonomous, the most highly internalized form of extrinsic motivation (*integrated regulation*) becomes possible. This is expected when EM becomes an integral and congruent aspect of one's identity, closely aligned with other domains of the individual's functioning, such as social relationships and career.

## A dynamic approach to EM

Affective and motivational influences are represented by one of the five main objectives of environmental education according to UNESCO as declared at the 1977 conference in Tblisi, namely, *attitudes*. This objective focused on **"**motivation for actively participating in environmental improvement and protection" (Hollweg et al., 2011, p. 2–1).

As Kaplan (2017) proposed and explained, not only overt actions, but also cognitions, including judgments are motivated. This motivational view of the mind involves the energetic formation of conceptual understanding (Lewis, 2010) as cognition and emotion constitute each other through temporal relationships (Lewis, 2005). It follows that the EM represents a "capacity to move from awareness to knowledge and action" (Roth, 1992, p. 22), which includes relationships between cognitions and emotions.

EM involves "affective influences on environmental concern and behavior, including sympathy for others" (Stern, 2000, p. 411) and the capacity to "care about the

environment" (Stevenson et al., 2013, p. 1). According to the present model, such tendences represent *care*. This motivation is essential for EM in terms of an appreciation of "the unity of humankind with nature" (Roth, 1992, p. 16). This broad motivation category is a major component of EM, including ecocentric (Liang, et al, 2018), biospheric and altruistic motivations (Stern, 2005). In the development of EM, care frequently *runs into* and relates to its opposite (Hegel, 1807/1977), namely, self-interest. In Hegel's dialectic approach of development, this is an *interpenetration* of care and self-interest, as they pass over into each other. Through repeated experiences of care and self-interest to form relationships, individuals build habits of EM. These habits represent specific relationships between the motivations of care and self-interest. Such habits can be seen as *attractors* in complex dynamic systems (Kaplan, 2017). An attractor is a pattern of experience that the system visits relatively frequently, a stable state that it gravitates toward (Lewis & Douglas, 1998; Thelen & Smith, 1994, 2006). From the present perspective, an attractor represents a specific relationship between self-interest and care, which is to some degree competitive and to some degree cooperative (van Geert, 1993). For example, care may serve self-interest, or self-interest may serve care. In the former relationship, care operates as the organizing principle; in the latter, self-interest operates as the organizing principle. As the individual encounters new problems in the social and physical environment, which oppose and relate self-interest with care, self-interest and care form new relationships in the dynamic system of motivation. EM develops through the construction, deconstruction and reconstruction of attractors, as the dynamic system of motivation moves between periods of destabilization (with high fluctuations) and attractor states that are relatively stable.

Environmental sensitivity was found to be among the core qualities of "encouraging clean living behavior" (Yusuf et al., 2022, p. 422). Similarly, altruistic values were associated with pro-environmental behavior (Stern, 2000, p. 411). These experiences represent a foundational motivation of care, which may lead to heightened concern about conditions that are harmful to human beings and other species (Stern, 2000, p. 413). Consistently, environmental concern was positively related to pro-environmental behavior in adolescents (Stevenson & Peterson, 2015).

Care is distinguished from the motivation of self-interest, which is another broad motivational category including what has been termed egoistic (Stern, 2005) motivations. The motivation of self-interest is also an integral aspect of the dynamic system of environmental motivation. Its regulation as well as relationships with the motivation of care influence the emergence of environmental behaviors. Considering the ubiquity of self-interest in motivating behavior, it can be considered as another attractor in the dynamic system of environmental motivation.

## Action and judgment as motivated environmental behavior

### Environmental decision making

Environmental decision making involves "an understanding about the ability to make choices" as well as "knowledge of decision making on environmental issues" (Loubser et al., 2001, p. 321). The environmental importance of decision making (Coyle, 2005; Hollweg et al., 2011; McBride et al., 2013) is built into the present CDS model of EM. Each judgment or action represents a particular decision. The temporal process by which multiple motivations compete and cooperate can be seen as a process of decision making out of which environmentally relevant behaviors emerge. The decisions in turn serve as inputs for the next iteration of the dynamic motivational system in the development of EM. Furthermore, at a meta-cognitive level, the development of EM involves increased understanding of how individuals' decision impact the environment locally and globally (Coyle, 2005).

Environmentally responsible behavior (ERB) arises from the operation of the dynamic motivational system, which evolves in connection with social and physical contexts. Scholars pointed out the complexity of ERB, which represents "the expression of knowledge, dispositions, and competencies within a context" (Hollweg et al., 2011, pp. 3–12). How can the emergence and development of ERB be facilitated? Mere information "typically has little or no effect in the short term" (Stern, 2005, p. 10789). As Nunez and Clores (2017) pointed out, environmental knowledge does not necessarily lead to corresponding pro-environmental behaviors, but it is more likely to be reflected in attitudes and sensitivity (p. 1212).

On the other hand, the communication of information is likely to be effective when it occurs during "the time and place of decision" and "is linked to the available choices" (Stern, 2005, p. 10789). This insight can be taken together with the premise of the CDS perspective that interventions are more likely to be effective during times of increased variability and fluctuation in the functioning of the system (Olthof et al., 2020). Thus, therapeutic interventions can be more effective if they occur during a phase transition, that is, when the individual is in a *sensitive period* of *destabilization* (Granic, 2005). For example, freshmen in a college dormitory can be viewed to experience a sensitive period in their psychosocial adaptation and development, as freshmen can fluctuate frequently between old habits and new

behaviors that are more adaptive in the college campus. An educational intervention that aims to strengthen the development and adoption of ERBs can start shortly after students arrive in college. This intervention can be part of new student orientation and continue with frequent reminders of ERBs (as well as behaviors that are environmentally harmful) with posters in resident halls, dining halls and other campus buildings throughout the academic year. Consistently, Stern (2005) pointed out key characteristics of the context in which information is communicated. That is, information must be conveyed personally and from trusted sources (p. 10789). The *personal* quality of information delivery is at least in part likely due to the facilitation of the need of *relatedness* in the learning process (Deci & Ryan, 2000). Returning to the foregoing example in this context; the quality of the relationships that resident advisors can build with new students in a college dormitory can facilitate the effectiveness of communication of ERBs by the resident advisors in meetings with students.

From the CDS perspective, a period of destabilization and increased fluctuation may be followed by a stable period (e.g., an attractor state) during which the system is more resistant to change. The phase transition from a highly variable state to a more complex stable state can be seen as *transformational* change (Overton, 2015). If the phase transition has been achieved into a more complex and adequate way of functioning in terms of environmental motivation (e.g., the development and internalization of a more environmentally responsible set of habits), this would be the development and experience of an attractor on behalf of care. In this attractor state, care serves as an organizing principle that governs self-interest. The resilience of this state can be seen as an asset, making the individual resist the temptation to go back to old (e.g., more egocentric) ways of acting, feeling, thinking and judging even in the face of perturbations (e.g., challenging experiences such as poor grades from courses or disappointments in social relationships). Then the development of EM can continue through *variational* (continuous) change (Overton, 2015).

On the other hand, if the motivational development of ERBs have not been adequately established during a sensitive period of transition, then the individual's motivational system may settle in a state that is less responsible environmentally and more self-serving, a stable pattern that may be more difficult to alter. This would be an attractor state on behalf of self-interest. In this state, which is reminiscent of the individual's old ways of being (rather than representing a novel transformation), self-interest serves as a governing principle controlling the operation of care.

As behavior is a key aspect of EM, an environmental citizen is proactive in addressing environmental issues by taking action (Roth, 1992, pp. 18–20). Building on the Tblisi declaration, scholars and educators emphasized the importance of "verbal and actual commitment to proenvironmental behavior" (Stevenson et al., 2013, p. 1). This particular emphasis reflects both judgments and overt actions as environmental behavior.

Judgments are also forms of behavior. Thus, we propose that environmentally relevant judgments and actions are both forms of environmentally relevant behavior. These could be pro-environmental behavior or those that could be harmful to the environment. Not only overt actions, but also judgments are motivated; they both emerge out of a dynamic motivational process in which multiple cognitive and emotional factors are inextricably related (Kaplan, 2017). The contention of Suryawati et al. (2020) is consistent with this formulation: environmental behavior is highly influenced by "cognitive and affective components" (p. 174).

The dynamic system of EM includes the contextualized operations of and relations between multiple motivations, including the motivations of self-interest and care. Motivation of care is reflected in sensitivity about the environment and other's people's well-being. Consistently, "altruistic or self-transcendent values" were associated positively, and "self-enhancement or egoistic values" were associated negatively with "proenvironmental personal norms" (Stern, 2000, p. 414). As personal norms are "internalized standards" (Stern, 2005, p. 10,788), the presence of personal environmental norms indicates the operation of SDT's identified regulation. Furthermore, pro-environmental personal norms represent a "sense of obligation" (Stern, 2005, p. 10,787) to take pro-environmental action. Therefore, internalized forms of environmental motivation are likely to facilitate ERB and make such behaviors more consistent and sustainable. This brings increased probability and strength of the motivation of care.

The emergence of environmental judgments and actions occurs in a dynamic motivational process, involving multiple motivations that may compete or cooperate. Due to differential activation (or emergence) of and relationships between self-interest and care, the emergence and inhibition of pro-environmental behaviors may be different both across individuals, contexts and types of behaviors. For example, "the failure of car and air travel to scale with other behaviors may be due to competing motivations serving as barriers to acting in accordance with attitudes or social norms" (Bratt et al., 2015, p. 465). Similarly, strong motivations for work achievement, social connections or recreation may compete with and reduce the effectiveness of pro-environmental motivation in certain contexts (Bratt et al., 2015).

Of particular importance in this process are the specific ways in which the motivations of self-interest and environmental care are constructed and related to each other. The strengths of self-interest and care, and the relationship they

form in the dynamic system of motivation shape the environmental judgments and actions that emerge. Figure 1 is an illustration of possible judgments or actions based on different strengths of and relationships between self-interest and care. Different strengths and relationships in a given context of environmental decision making may give rise to different judgments and actions.

## The development of EM

EM is a developmental phenomenon based on dynamic relationships between cognition, emotion and action. It requires "the development of attitudes, approaches, ethics, skills and related knowledge and concepts" in connection with daily decision making (Gayford, 2002, p. 106). The development of EM is not linear. Rather, it "tends to involve regular or intermittent interactions among the main components" (Hollweg et al., 2011, p. 3–1). According to the present CDS perspective, EM develops as the individual's dynamic system of environmental motivation evolves. This system evolves as a function of its own existing state of moral motivation, and the availability of resources in specific contexts (e.g., support for autonomy, relatedness and competence in the context of environmental behavior), which facilitate change by influencing moral motivation.

The present approach to EM affirms the progressive tradition of Dewey, viewing *development as the aim of education* (Kohlberg & Mayer, 1972). In turn, taking development seriously can facilitate the processes of understanding the complexities of EM and promote its development. Consistent with the progressive tradition, the development of EM involves the development of adaptive skills, and requires meaningful encounters with real-life problems (Coyle, 2005). During these encounters, the learner is guided and supported toward performances of action and understanding that reflect increasingly stronger *internal adequacy* as the criterion for development (Kohlberg & Mayer, 1972). Such guided developmental encounters may include "practices... such as issue identification, generating multiple possible solutions, and evaluating those solutions to choose the one that best fits the social-ecological system" (Hunter & Jordan, 2022, pp. 3–4).

### Iterative and individualized process of change

EM develops in an iterative process. Present experiences emerge by building on past activity, and serve as building blocks for future experiences. The system develops by building on its own activity, rather than merely as a function of environmental input. It follows that "taking one pro-environmental action" influences "subsequent actions" in positive or negative ways (Stern, 2011, p. 311). The direction and magnitude of this influence are not likely to be uniform across individuals, behavior types, and contexts. Rather, the direction and the magnitude of influence are likely to display substantial variability. For example, in the emergence and change of environmental behaviors "different factors matter to different individuals at different times with regard to any particular behavior" (Stern, 2005, p. 10,788). Thus, individualized and contextual approaches are needed. Such approaches take variability seriously as meaningful.

Hollweg (2011) emphasized a developmental process of turning intentional behaviors, which originally "require purposeful thought" into habit (pp. 3–12). Such development is an *iterative* process of repeating behaviors at different time points and various contexts. "With enough experience, intentional behaviors can become habitual" as "habitual behaviors are the result of multiple expressions of intentional behaviors" (Hollweg et al., 2011, pp. 3–13). It follows that repeated experience in relevant, real-life contexts is needed for the development EM. Consistently, Stevenson (2013) pointed out that "time outdoors is one of the only factors that significantly impacts Knowledge, Affect, and Behavior" (p. 9). We suggest that this factor is likely based on iterative experiences of human–environment interactions, rather than being based merely on the passage of time outdoors.

The formation of attitudes and behaviors is dynamic, variable and contextual. There is multiplicity in this process:

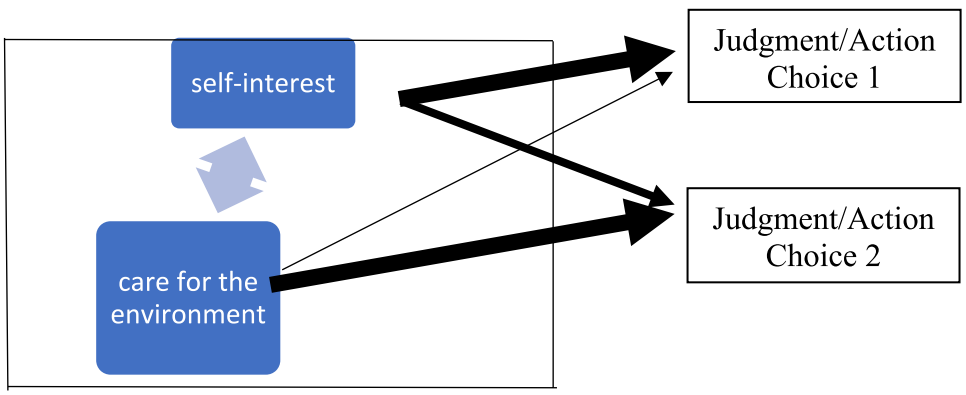


**Fig. 1** The emergence of environmental behavior (judgment and action) based on relationships between multiple motivations (adapted from Kaplan, 2019). Note: The sizes of boxes and arrows represent the notion that different motivations have different strengths, and they exert different degrees of influence on each other and on the probabilistic emergence of specific judgment and action in a specific context

multiple factors are involved and related to each other in the determination of judgments, actions, and attitudes. As "different types of causal factors may interact", reductionist explanations may be misleading (Stern, 2000, p. 418). Rather than focusing only on contextual or personal factors, multiple sources of variations and their relationships must be taken into account (Stern, 2000, 2005).

The development of EM and the emergence of environmentally relevant behaviors are subject to *multicausality* (Kaplan, 2017; Smith & Thelen, 2003). Applying the CDS perspective, we can view the development of EM as a process in which "no single element has causal priority" (Smith & Thelen, 2003, p. 344). Environmental behavior is "the emergent product of many decentralized and local interactions that occur in real time" (Smith & Thelen, 2003, p. 343). This is the process of self-organization by which a system functions and develops through spontaneous relationships of its components in ways that are not pre-programmed (Lewis, 2005). Through self-organization in the development of EM, novel forms of understanding, feeling, acting, judging and valuing about oneself and the environment can emerge. Thus, the present CDS framework represents a relational approach (Overton, 2006, 2015) rather than an approach based on fixed and isolated components.

Kaplan's (2017) figure of microdevelopment of moral motivation can be directly applied to characterize the short-term development of EM, as presented in Fig. 2.

According to this iterative CDS model of EM, the dynamic system of environmental of motivation develops as a function of its own activity (van Geert, 2009a), building on its own earlier states, receiving input from its own emerging judgments and actions, as well as from the dynamically evolving context.

The iterative nature of individual's environmental behavior is reflected in possible effects of "one pro-environmental action on subsequent actions" (Stern, 2011, p. 311). These effects are likely to display substantial variation across individuals and contexts. "Some arguments predict positive 'spillover' effects" and "others predict negative effects" that may "undermine potential energy savings" (Stern, 2011, p. 311).

The development of EM is a function of the degrees to which its components have developed and integrated within the individual's dynamic system of motivation. On the basis of such increased integration, the development of environmentally responsible dispositions and habits (Hollweg et al., 2011) may become possible. As individuals have uniquely different profiles in terms of the evolution of their dynamic motivational systems, educational approaches to facilitate EM must take into account the individualized nature of environmental motivation and development. Substantial interpersonal variability in people's motivational states is due to both personal and contextual factors, which are interconnected. As context is an integral aspect of individual's motivational functioning, the kinds of approaches and interventions that would be effective depend in part on the developmental state of each individual. This approach can inform the "ongoing debate about whether people will take proenvironment steps on their own or if they need prompting from laws, regulations, public policy, or peer pressure"

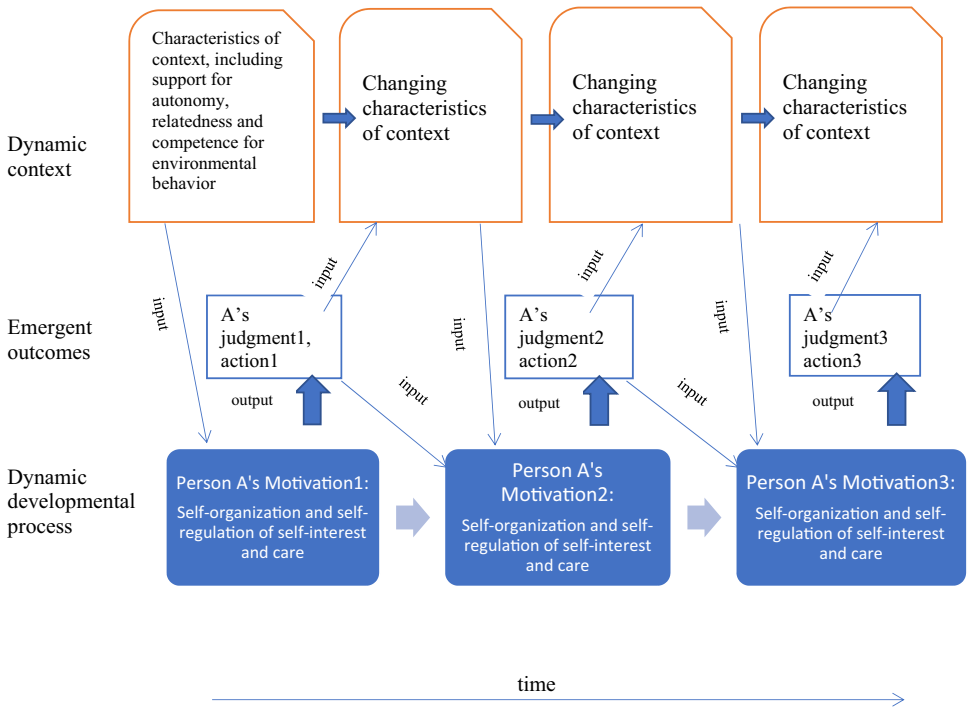


**Fig. 2** Short-term (micro level) development of the dynamic system of environmental motivation, including the emergence of judgment and action in a dynamic context (adapted from Kaplan, 2017). Note: self-organization of multiple motivations means spontaneous relationships between them. Self-regulation of multiple motivations means their regulation by the self

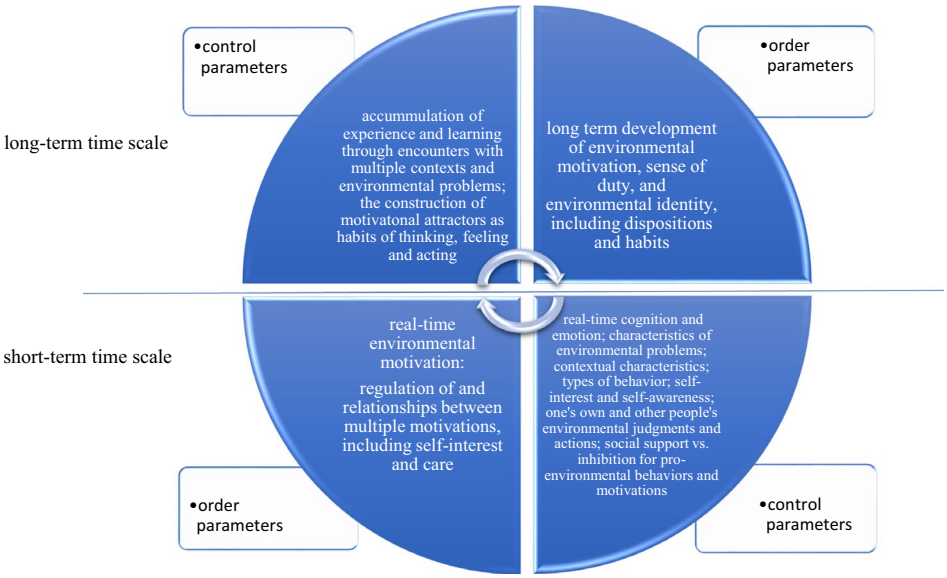


**Fig. 3** The operation and development of environmental motivation over short-term and long-term time scales (adapted from Kaplan, 2017)

(Coyle, 2005, pp. 34–35). Not only it is the case that "both are important: environmental education works best in the context of an environmentally supportive society" (p. 35), but also the educational interventions can be adjusted and customized based on an understanding of the motivational and developmental states of individuals and groups.

## Connecting short-term and long-term development

The notion of *motivational attractor* is particularly useful for connecting short-term and long-term development of EM. As described earlier, people build attractors in EM as habits of thinking, feeling and acting. An attractor represents a specific relationship between self-interest and environmental care. This relatively stable state of motivation leads to consistent judgments and actions in real-time, which in turn reinforce the attractor state. The enduring construction and experience of attractors over time across multiple contexts of environmental decision making constitutes the long-term development of EM, including the development of environmental duty and identity.

Environmental judgments and actions emerge through short-term activity in the dynamic system of motivation. Repeated short-term motivational experiences serve as building blocks for long-term development of EM. To connect short-term and long-term developments more specifically, order and control parameters can be identified. An order parameter is "a parameter, dimension or variable that specifies a specific macroscopic order, pattern, structure or regularity of the micro-components of a system" (Lichtwarck-Aschoff et al., 2008, p. 387). It is "a function to identify and differentiate likely manifestations of a phenomenon" (Kaplan, 2017, p. 212). On the other hand, "specific factors that influence these manifestations are control parameters" (Kaplan, 2017, p. 212). In this context, Kaplan's moral motivational application of Siegler's (1996) work is directly relevant. Accordingly, multiple environmental motivations can function as strategies. The dynamic system of environmental motivation can evolve over time by virtue of many iterative steps in real-time through (a) *acquisition* of new strategies, (b) *mapping* strategies onto novel situations, (c) *strengthening* the use of new strategies, (d) *refining choices* in the application of strategies, and (e) increasing the effectiveness of *execution* of strategies (Chen & Siegler, 2000). These five experiences can be seen as control parameters that connect short-term functioning with long-term development. Environmental identity, habits and dispositions can be viewed as long-term order parameters. Control parameters influence the intensity and impact of identity, habits and dispositions. Specific environmental cognitions, emotions and motivations are short-term control parameters.

Moral identity is a higher-order structure that influences real-time self-organization. The characteristics of the dynamic context, including the type of environmental behavior can be identified as control parameters, as these are associated with differences in the emergent environmental behaviors. Other attributes of the dynamic context such as the qualities of the educational environment, presence of support for basic needs can be viewed as control parameters.

Based on the foregoing ideas, a model connecting short-term and long-term development of EM is presented in Fig. 3, as an adaptation of Kaplan's (2017) model of moral motivation.

## The complexity of EM

Issues surrounding the environment and its connection with human life are complex. However, complex issues are often oversimplified in public discourse and understanding, resulting in misconceptions (Coyle, 2005).

EM is comprehensive, involving multiple, components and capabilities, as well as relationships with multiple contextual factors (Stern, 2005). Complex relationships between individuals and situations (Stern, 2005, p. 10,788) require approaches that take into account both general principles and the individualized nature of environmental behaviors. Such complexity was reflected in Cheng and So's (2015) study of teachers' environmental literacy, indicating relationships between individual background, motivation and environmental commitment.

As Hunter and Jordan (2022) asserted, there is complexity in perception of and concern about environmental issues, which are influenced by multiple factors (p. 13). Similarly, EM entails multiple forms of knowledge including being able to identify multiple environmental issues in a variety of contexts (Hollweg et al., 2011). Such knowledge and understanding must be reflected in decision making and action (McBride et al., 2013, p. 2).

EM is about real-life functioning, including environmental attitudes, feelings, skills and behaviors, beyond mere information. The development of EM requires responsible decisions as well as willingness to act on such decisions to enhance the well-being of individuals and the welfare of societies (Hollweg et al., 2011, p. 2–5). In that context, Erdoğan et al. (2009) called particular attention to the components of "value and action" as requiring integrative approaches, bringing together "knowledge, emotion and action, i.e., 'heads, hearts and hands'" (p. 24).

Recognizing the complexity of EM is a practical problem, important for environmental education efforts. Pointing out the need for in-depth understanding of complex environmental issues and skillful application of knowledge, Coyle (2005) asserted that "what passes for environmental *education* in America is usually environmental *information*" (p. xvii). As the complex nature of EM involves skills, sensitivity, motivation, judgment and action, effective approaches to facilitate EM also require pedagogical skills beyond the transmission of information (Coyle, 2005). Furthermore, from the present CDS viewpoint, even learning through transmission of information relies on a constructive process based on inherent activity of the learner's mind (van Geert, 2009b).

## A relational perspective

According to the relational paradigm, "the identities of objects and events derive from the relational context in which they are embedded" (Overton, 2006, p. 32). Phenomena are explained in terms of processes and relationships rather than assumption of fixed, foundational entities (Overton, 2015). Due to the complex and dynamically changing nature of environmental issues based on interrelationships between multiple systems, the experience and development of EM requires a relational perspective. Consistently, one of the ten core concepts for environmental literacy according to Loubser et al. (2001) is "awareness of *human interactions* with the environment and interrelationships in an ecosystem" (p. 321). Individuals who adopt a relational perspective may be more likely to develop EM. In turn, a relational perspective can help scholars and educators understand and facilitate more effectively the development of EM.

Components of EM must be considered, not in isolation, but in terms of how they relate to each other (Nunez & Clores, 2017, p. 1197) over time and in a *wide variety of environmental contexts* (Hollweg et al., 2011, p. 2–5). Appreciation of such relational complexity is emerging in the literature on environmental education and learning (Cheng & So, 2015; Hunter & Jordan, 2022). This manifests as recognition of multiplicity in the emergence of environmental behaviors. For example, scholars emphasized the importance of multiple forms of knowledge, including multiple systems and their interrelationships (Hollweg et al., 2011). According to Stern et al. (2016), there is "a multi-dimensional space of human action on climate and energy issues" (p. 547). This is consistent with evidence indicating a "multidimensional structure" for "environmentally significant behavior" (Bratt et al., 2015, p. 437).

## Multiple motivations

Van Geert (1993) explored and explained change in terms of competitive and supportive relationships between multiple components of a dynamic system. This notion is directly applied in the present model according to which environmental action and judgment emerge through relationships between multiple motivations. Furthermore, the dynamic system of EM evolves as a result of these temporal relationships between specific motivations.

Stevenson and Peterson (2015) examined the environmental motivations of adolescents in terms of hope, concern and despair. The authors found that hope and concern about climate change were positively and independently associated with pro-environmental behavior, while despair was negatively associated. While this study did not find an interaction between these three factors, it is important to take

into account that this was a cross-sectional study based on group-level statistics. Examinations of individuals' motivational activity and change over time may reveal individualized relationships between multiple motivations in the emergence of environmental judgments and actions.

From the present viewpoint, the components of EM (e.g., knowledge, skills, affect, behavior) are not isolated; rather, they are highly interconnected. This interconnectedness is present and important in at least two ways. First, the constitution of each component involves elements of other components the components. For example, cognition has a basis in action and emotion, and affect itself is based on action and cognition (Kaplan, 2017). Second, the development of EM requires increased integration of the components. For example, "skills required to identify problems and solutions" (Stevenson et al., 2013, p. 2) are not just cognitive, but also behavioral and emotional. Such an integration is also important for the experiential characteristic of being proactive, alert and aware about environmental issues, which EM requires. Such a characteristic involves "a willingness to act before the problems can be adequately addressed" (Stevenson et al., 2013, p. 2).

This is a kind of heightened alertness and sensitivity that reflects readiness to act, which is a motivational quality. It would be misleading and reductionistic to call this quality only—or even partially—cognitive, or emotional, or behavioral. Rather, it is 100% cognitive, 100% emotional, and 100% behavioral, all at the same time (Overton, 2006, 2015). EM is a unified experience, where the components are inextricably interconnected. Thus, any classification that distinguishes components of EM must be based on flexible, fuzzy and dynamic boundaries (van Geert, 2002), rather than strict distinctions. Applying van Geert's perspective, EM develops and environmental behavior emerges "as a result of the time-governed interplay among the factors" (p. 321). Furthermore, "it is impossible–not only in practice but also in principle–to draw a sharp line between the factors or to specify their properties in a 'crisp' way" (p. 321).

This is also true for the distinctions between the person and the educational context. Because *behavior is a function of the total situation* involving both personal and contextual factors (Lewin, 1946), context must always be considered when we focus on behavior and the person (van Geert, 2002). The work of Hunter and Jordan (2019, 2020, 2022) from a *contextual perspective* is consistent with this contention. It follows from the CDS perspective that EM is a function of temporal relationships between the properties of person and the properties the contexts in which learning takes place. Both the person and the context are dynamic; they change over time.

Bratt et al.'s (2015) discussion of the complexity of environmental literacy particularly resonates with the present perspective of EM. Stern emphasized variation in the relationships between psychological factors and environmentally significant behavior. Specific characteristics of "the behavior and its context" are among the sources of such variation. That is, "values, attitudes and beliefs" are more strongly associated with behavior in some contexts and for certain types of behaviors than others. Consistently, Bratt et al. (2015) concluded that "a more complex structural model may be needed than one based on a search for commonality and focused only on variables such as attitudes and values" (p. 438). The present study offers such a model.

## Dynamic context and contextual variation

The emergence of environmental behaviors is contextually specific. This specificity "makes energy users highly heterogeneous" and requires "a context-sensitive science of energy and climate choices" (Stern et al., 2016, p. 553). According to the CDS perspective, both the motivational system and the context are dynamic. Context changes in ways that are interconnected with human activity through reciprocal influences. Individuals–whose activities are influenced by context– are active agents, influencing their contexts over time.

Some of the interventions that aim for behavior change focused directly on contextual changes. Behaviors that "directly affect resource consumption or cause pollution" could be changed by focusing on the context in which they arise, as "interventions in the context are often more effective than directly targeting individuals with verbal appeals" (Stern, 2005, p. 10,790).

EM operates through "*a range of environmental contexts*", including various forms of *personal* and *social* contexts, representing "a variety of life situations– contexts– that range from local to global" (Hollweg et al., 2011, p. 5–17). Contexts are variable, and EM is "situated" and subject to development in "dynamic context" (Hunter & Jordan, 2022, p. 3). Thus, EM is dynamically variable based on the individual's experience with contexts.

Due to contextual variation and the "multidimensional nature" of environmental behavior, the emergence and sustainability of environmental behaviors in different contexts such as "the home, the car, and on vacation" are expected to be different. It is not surprising for correlations between such behaviors to be low (Stern, 2005, p. 466). Thus, the structures of environmental behaviors in three different domains, namely, "home-based actions, car use, and air travel for vacation", were found to be quite distinct, "with little or no correlation" (Bratt et al., 2015, p. 436).

Contextual variation also includes information about and experience with different domains of sustainability, such as

microplastics, CO2 emissions, and a variety of commercial products of modern life (including chemical substances) that carry risks for human health and environmental sustainability. Each category of possible risk can be viewed as a different context. Within each context, knowledge of such risks and the motivation to act on such knowledge are dimensions of intrapersonal and interpersonal variation in the dynamic system of EM.

The present paper offers a CDS model to specify and examine this dynamism of EM. This model also utilizes the framework of SDT, particularly in terms of the development of motivation and the importance of basic needs.

## Context and the emergence of behavior

The influence of contextual forces on behavior is variable. According to the ABC (attitude, behavior, context) theory, when contextual forces (such as rules, regulations, norms, financial rewards or penalties) are strong, personal factors do not have much influence on behavior (Stern, 2000, 2005). When this contextual impact is neutral, behavior is expected to be consistent with attitude. On the other hand, this is not a clear-cut and uniform relationship; it is likely to vary substantially across individuals and types of behavior. Hence, personal attitudes and motivations can make a difference even for behaviors that are known to be constrained by contexts (Stern, 2005, p. 10,788). This is another aspect of the individualized nature of EM as a complex dynamic system. Furthermore, there are cases when contextual factors are resistant to change or the individual does not have the resources change them. In such cases "personal factors", including the motivational experience of the individual may constitute "the only levers on behavior" (Stern, 2005, p. 10,786).

Stern (2005) suggests that four sources of influences (contextual factors, personal capabilities, habit and routine, and attitudinal factors) set limits on behavior. Within these limits, specific behaviors may emerge and can be changed. When individuals experience low internal locus of control (not believing that their behavior makes a difference), they are more likely to rely on external reinforces rather than being "motivated to act by an internalized sense of obligation" (Stern, 2005, p. 10,788). According to SDT, this represents external motivation, the lowest level of extrinsic motivation, based on external rewards or punishment. By contrast, behavior based on internalized motivations will be more reliable and sustainable. Consistently, Chiang et al. (2019) found that internal locus of control was associated with pro-environmental behaviors.

Behavior can be changed by increasing people's awareness of consequences about things that they value, revealing that their actions matter (Stern, 2005, pp. 10787–10788). According to SDT, such an increase in awareness can be a process of internalization or increased autonomy (Ryan & Deci, 2000) with regard to specific environmental behaviors. It is possible to experience environmentally significant values, thoughts, feelings, judgments and actions according to introjected regulation (to get approval or avoid guilt), identified regulation (because it is personally significant and worthwhile), or integrated regulation (because it is thoughtfully considered and willfully chosen) (Chirkov et al., 2003). More specifically, for any given environmental behavior, multiple levels (external, introjected, identified, integrated) may operate in different degrees; but as experience becomes more internalized, higher levels of self-regulation operate more strongly.

## Support for basic psychological needs

A major implication of SDT is that support for three basic needs (autonomy, relatedness and competence) must be built into efforts and programs for facilitating EM. According to the present CDS model of EM, support for basic psychological needs is a highly variable aspect of contextual characteristics (property of the dynamic context), interconnected with the functioning of the dynamic motivational system.

Relatedness.

Relatedness is a key motivational factor toward pro-environmental behavior. Accordingly, "social or community context appears to be one of the key factors that can motivate people to take pro-environment actions" (Coyle, 2005, p. 34). Relatedness can take the form of solidarity and social support for EM. The absence of such solidarity can reduce pro-environmental motivation (Coyle, 2005, p. 34). The key role of social interactions in facilitating or weakening the development of environmental identity (Stapleton, 2015) also confirmed the importance of relatedness as a basic need in the development of EM.

Competence.

The fulfillment of the need for competence can be increased by providing effective communication about environmental protection. For example, clear public communication campaigns to promote simple pro-environmental behaviors can be effective, as "people respond positively on the environment when they know what to do" (Coyle, 2005, p. 34). A related way for supporting competence is to increase "access and convenience", which reinforces "a feeling of being in control". Consistently, "curbside recycling has been more successful than asking people to take materials to local recycling centers" (Coyle, 2005, p. 34).

Autonomy and agency in EM.

Conceptually differentiated from individualism and independence, autonomy represents agency, self-regulation and ownership (Chirkov et al., 2003). In this sense, autonomy

is essential for the development of EM, which requires increased internalization of environmentally related cognitions, emotions and behaviors. Autonomy is also reflected in the EM-related capacity to be proactive about relationships between human activity and the environment. This quality involves a developmental approach of expanding one's own understanding, skills and self-awareness, awareness of cultural dynamics, as well as working toward "optimum development of human potential and the integrity of the ecosystem" (Roth, 1992, p. 19). The agency and alertness of an environmentally literate citizen includes a commitment to life-long learning, continuing to expand and update environmental knowledge and understanding throughout the life span (Roth, 1992, p. 19).

## EM as a moral phenomenon

As part of implications of their empirical study, Liang et al. (2018) pointed out the need for examination of moral factors in pro-environmental behaviors. The present study can be a step in this direction toward illuminating the connection between morality and environmental behavior and motivation.

Moral motivation is the process by which moral judgment and action emerge (Kaplan, 2017). What makes a particular motivation morally relevant is its involvement (including possible transgressions) of duties and obligations toward others. In a broad sense, morality includes duties and obligations toward human welfare and other life forms in the planet, involving basic respect for life itself (Kant, 1785//1996). Loubser et al. (2001) emphasized "*respect for all living things*", reflecting "knowledge of environmental ethics as a way of life" (p. 321).

The duty or obligation in the context of EM is about responsible use of resources that affect the environment. This duty has a knowledge base in close connection with its affective and motivational base. It also has a foundation in the development of skills for responsible use of resources in ways that promote sustainable environmental systems. Environmental education must cultivate the development of skills, knowledge and understanding for *sustainable development* (Gayford, 2002).

An environmentally literate citizen "is humane" (Roth, 1992, p. 19). According to Roth, this sense of humanity is based on utmost respect for all living things, which are recognized to be interconnected. This is an extension of Kant's (1785/1996) categorical imperative that applies to all rational beings. This imperative involves acting "as if the maxim of your action were to become by your will a *universal law of nature*" (p. 73), and acting in a way that "you use humanity, whether in your own person or in the person of any other, always at the same time as an end, never merely as a means" (p. 80). Thus, according to Kant, the essence of morality is his developmental vision based on the conscious and voluntary union of the individual will with the well-being of humanity. This vision involves a subordination of personal inclinations to the individual's union with humanity. This notion is reflected in the account of Schopenhauer (1903) in terms of an interconnectedness of all human beings as a source of compassion and care, which is the basis of morality. EM is the application of such universal morality in the environmental domain, with the aim of being "motivated toward the rational use of the environment in order to develop the highest quality of life for all" (Roth, 1992, p. 20).

## Environmental duty and identity

Duty is central to ethics. This centrality is reflected in the philosophies Bentham, Kant and Hegel. According to Bentham (1780/1823), ethics is "the art of discharging one's duty to one's self", as well as "the art of discharging one's duty to one's neighbor" (p. 312). The former is identified by the quality of prudence; the latter by the qualities of probity and beneficence. Kant (1797/1996) examined ethics and virtue in terms of the individual's duties to oneself and duties to others. Hegel (1817/1894) proposed that the "underlying essence" of duty is experienced as the individual's "own very being" (p. 277). While the sense of duty is an abstract, higher order experience (Hegel, 1807/1977), environmental duty can inform and guide everyday (real-time) actions and judgments. The process of carrying out proenvironmental behaviors in turn strengthens the development of environmental duty.

Two necessary foundations of duty are (a) conviction and (b) readiness to sacrifice. The first foundation represents commitment; the second renunciation. Without willingness to sacrifice, duty and ethics may turn into mere subjective belief, judgment and desire, "reduced to the special theory of life held by the individual and to his private conviction" (Hegel, 1820/1952, p. 142). Even a certain aspect of self-interest may become the individual's duty, but this can only occur and qualify as duty if it involves a readiness to sacrifice other forms of self-interest. Without this readiness, the person desires to take without being willing and ready to give, failing in the exchange relationship that is necessary for the sustainability of life (Hegel, 1820/1952). As "the essence of the will" (Hegel, 1820/1952, p. 126), duty is a voluntary submission of one's will to a self-chosen cause. It involves "subjecting one's will to discipline and so elevating it to free obedience" (p. 249).

In light of these insights, we propose that the experience of duty has the following core characteristics, which directly apply to the environmental domain. Duty represents:

- dedication to and identification with a cause.
- conviction.
- readiness to sacrifice self-interest.
- experience of production and creation rather than consumption (giving oneself to duty involves abandoning a consumption-centered state of being).
- a sustained experience rather than momentary behavior.
- intrinsic motivation.
- opportunity for increased mastery and competence.

## Environmental commitment, duty and identity

The development of EM involves "personal investment in the environment" (Stevenson et al., 2013, p. 2), including a sense of responsibility and commitment to address and act on environmental issues (Roth, 1992, Hollweg et al., 2011; Erdoğan et al., 2009). Considering that the object of this commitment is environmental protection (rather than one's own immediate self-interest), environmental commitment is likely to qualify as an experience of duty.

Environmentally responsible behavior reflects "a commitment to sustainability" (Stevenson et al., 2013, p. 1), representing a sense of duty. Environmental commitment is a key aspect of sustained ERBs (Goldman et al., 2006). According to Erdoğan et al. (2009) environmentally responsible behaviors are "accompanied by strong conviction of personal commitment and responsibility" (p. 17). An example of this experience is increased responsibility for and commitment to "the management of environmental resources" (López-Alcarria et al., 2021, p. 1).

McBeth and Volk (2010) identified pro-environmental behavior as commitment (p. 62). The experience of commitment in EM reflects taking personal responsibility for environmental protection. Such commitment and responsibility involve dispositions or tendencies increase pro-environmental behaviors and reduce those that are damaging (Hollweg et al., 2011, pp. 3–6).

Pro-environmental behaviors emerge from the dynamic system of moral motivation. This system operates in real-time (microdevelopment) in close connection with macro-level properties such as identity. Consistently, according to Kempton and Holland's theoretical framework, environmental identity is linked with environmental behavior. Their sustainability (consistently pro-environmental behaviors) is influenced by including identity, which involves dispositions. As part of the development of environmental identity, dispositions develop in long-term time scale. In turn, dispositions may play key roles, promoting or inhibiting pro-environmental behaviors in real-time. Dispositions may guide attention, and influence people's "motivation to participate in public deliberations about environmental issues" (Hollweg et al., 2011, pp. 5–9).

As a key aspect of EM, a sense of commitment reflects the degree to which environmental sensitivity and behavior have been internalized as expressions of one's identity. From the SDT perspective, this experience represents strong operations of identified regulation and integrated regulation. To the extent that such environmental commitment is an integral aspect of one's dynamic motivational system, the frequency and the quality of the environmentally responsible actions and judgments will be enhanced. This increased internalization reflects a sense of identification with environmental issues, including "a sense of autonomy and ownership about the decisions that are made" (Stern & Raimi, 2015, pp. 602) rather than such issues being perceived as outside of or alien to the self. Educational approaches that increase involvement, internalization, autonomy and a sense of ownership will facilitate EM (Coyle, 2005).

Based on their study, Cheng and So (2015) suggested an important link between commitment and intrinsic motivation in environmental behavior. Furthermore, they suggested that personal commitment can be enhanced by instituting a systemwide commitment to environmental education (p. 70). Hunter and Jordan (2019) found that environmental identity was strongly associated with environmental behavior, as well as knowledge and self-efficacy. Hunter and Jordan (2022) emphasized identity as an example of *dispositions toward environmental systems* (p. 1). Also, in the study of Cheng and So (2015), *individual commitment* was found to be a key factor for environmental behavior.

Commitment and identity are also reflected in the importance of personal norms and values (Stern, 2005). In particular, personal norms may become active when the things that the person values are threatened (awareness of consequences), and when the individual believes that taking action would bring responsibility for the consequences (ascription of responsibility) (p. 10787).

EM is an open system that is responsive to inputs from the social and educational context. This quality is important for the development of the system, including behavior change. For example, communications that point out the significance and possible consequences of individuals' environmental behavior could be instrumental "to active personal altruistic norms and change behavior" (Stern, 2005, p. 10788). Pedagogical approaches that facilitate and reinforce such understanding (that 'my behavior matters for the environment and other people') can be effective in the development of EM and the promotion of ERBs.

Environmental identity is closely associated with environmental action and awareness (Kempton & Holland, 2003; Stapleton, 2015). From the CDS perspective, reciprocal

influences over time are likely to characterize the relationship between environmental identity, action and awareness, rather than one-way influences or determination. That is, the development of serves as a source for increased environmental action and awareness, which in turn facilitate further identity development. In addition, environmental action is likely to expand awareness, which in turn raises capacity for further and more informed action in new contexts.

According to Kempton and Holland's (2003) framework, there are three changes in the process of environmental identity development: (a) "salience" (p. 332), which represents a "waking up" (p. 332) and "transition to awareness" (p. 333), (b) "identification with the world of environmental action" (p. 333), and (c) "increasing practical knowledge and other resources for action" (p. 335). The second change represents personal investment in and responsibility for environmental action.

Stapleton (2015) proposed five major characteristics of environmental identity. Accordingly, environmental identity.

1. Is malleable over time;
2. Is tightly connected to practice;
3. Is continually informed by and recreated through social interactions;
4. Simultaneously exists on multiple levels: global/local and micro/macro scales; and.
5. Can be largely impacted by education and schooling. (p. 97).

These qualities represent identity as a dynamic experience that can evolve in connection with contexts, as the present CDS model proposes.

Repeated short-term activities constitute the long-term development of environmental identity, which in turn can influence real-time motivational and behavioral functioning. Thus, while identity develops in long-term time scale, it operates in real time environmental motivation, in the emergence of action and judgment. This operation can take place through habits and dispositions. An important area of this operation is the capacity to regulate self-interest, which can otherwise undermine pro-environmental behaviors and lead to environmentally damaging behaviors. The development of environmental identity can serve as a source of resilience against the temptation of self-interest. In keeping with the principles of the CDS framework, this is an example of how short-term functioning and long-term development of EM are closely linked.

## The construction and regulation of self-interest

Studies have examined the relationship between environmental knowledge and action (Coyle, 2005), as well as between attitudes and behavior (Hollweg et al., 2011). According to accumulated evidence, these links are neither negligible nor ubiquitous and straightforward. Rather, there are moderate positive relationships; however, the relationships are complex and variable, depending on context, individuals, and the type of behavior. We propose that one key determinant is the construction and regulation of self-interest, including willingness for self-sacrifice (Fang et al., 2020), which many pro-environmental behaviors demand.

According to Schopenhauer, there are three "fundamental springs of human conduct" (Schopenhauer, 1840/1903, p. 171): egoism, malice and compassion. In Schopenhauer's formulation, egoism directly represents self-interest. It is possible to see these motivations, not as mutually exclusive single determinants, but as integral components in the plurality of the dynamic system of motivation this is a simplistic approach. In that sense, the way self-interest is constructed and regulated by the individual can influence environmental behavior, in combination with other motivations.

From our perspective, not only objectively measurable incentives, but more fundamentally, the psychological construction of self-interest (what the individual perceives and believes to be self-interest) may influence environmental behavior directly. What people perceive to be beneficial to the self varies across individuals and contexts. *Interest* varies as the *self* develops. Thus, the motivation of self-interest is psychologically constructed and variable, depending on personal, environmental and developmental factors. This construction may also mediate the relationship between knowledge and behavior.

The motivation of self-interest is crucial for the development of EM, particularly in terms of environmentally relevant judgments and actions. EM requires proper regulation of self-interest so that it does not dominate judgments and action toward environmentally irresponsible behavior. For example, rejecting "short-term gains when they threaten long-range benefits" (Roth, 1992, p. 18) may be a part of the development of EM. Thus, EM calls for certain forms of self-sacrifice, particularly when self-interest conflicts with environmental protection (Fang et al., 2020). For example, "committed actions such as volunteering, contributing to a conservation organization, and other activities that require time, energy, and sometimes money" (Coyle, 2005, p. 63).

The development of EM requires being willing to relinquish certain forms of self-interest, reflecting "a willingness to curtail some individual-privileges, and even rights to certain resources, for the long-range public good" (Roth, 1992,

p. 19), that is, for the sake of utility according to Bentham (1780/1823). It follows that while at a social level, educational and institutional contexts can be structured according to Bentham's *duty and interest junction principle*, the merging of environmental duty and self-interest may not always be possible at the individual level, as the sacrifice of self-interest may be necessary for the sake of environmental protection. This notion applies the principle of utility (greatest good for the greatest number of people) to the proposition that people are naturally inclined to act in their own interest. Accordingly, institutions, laws and educational interventions can be designed in such a way that by fulfilling their duties and serving the greatest good, people can also be satisfying their own needs and interest.

In the emergence of pro-environmental behavior, two key questions are 'what is the personal cost?', and 'am I able and willing to afford the cost?'. When the cost is perceived to be simple and affordable, more people—who have basic environmental awareness– are likely to carry out a particular pro-environmental behavior. For example, many people expressed "willingness to pay modest premiums for environmentally less-polluting products" (Coyle, 2005, p. 36).

When context does not demand, require or reinforce a particular behavior, "the more difficult, time-consuming, or expensive the behavior, the weaker its dependence on attitudinal factors" (Stern, 2000, p. 416). The personal cost of behavior reduces its association with attitude. Concerns about self-interest may weaken the emergence of pro-environmental behaviors. Consistently, the motivation of self-interest may reduce the probability of the kinds of pro-environmental behaviors that are perceived to be disruptive to people's lives (Coyle, 2005, p. 34).

Suryawati et al. (2020) explained pro-environmental behavior in terms of the ability to think systematically. The absence of such thinking is presented as a reason for not taking pro-environmental action. We present a different, motivational explanation in terms of the development and regulation of multiple motivations, including the motivation for self-interest and motivation for care.

The notion that pro-environmental behavior requires some form of sacrifice supports the possibility that self-interest reduces the likelihood of such behaviors. However, this relationship is more complex. It is also possible for self-interest to facilitate pro-environmental behavior. This complexity reflects (a) the individual construction of self-interest, and (b) the importance of contextual properties for environmental behavior. As an example, *financial incentives* have been effective for encouraging energy efficiency in households (Stern, 2005, 2011). According to SDT, this corresponds to external regulation for pro-environmental behavior. In the development of EM, it is possible for more internalized forms of regulation (such as identified and integrated regulation) to become more strongly operative.

We propose that as an aspect of individual differences, the construction and regulation of self-interest contributes to interpersonal variation in environmental behavior. The motivation of self-interest is closely connected to the formation and persistence of habits. Many of our habits are strongly influenced by the need to preserve and enhance self-interest. These habits may affect the emergence and the strength of ERBs. For example, even when individual has personal norms in favor of environmental protection, self-interested habits may compete with such norms, and weaken their force. As a result, pro-environmental judgment or action may be less likely to occur.

The construction of self-interest in relation to environmental care can be seen as a dimension of both intrapersonal and interpersonal variability. That is, the construction, scope and meaning of self-interest are likely to undergo changes over time and across context for each individual (intrapersonal variability) and also display major differences across individuals (interpersonal variability). As an example of the latter, a person who does not believe in or is not aware of the connection between human activity and environmental health is likely to construct self-interest in relation to environment in ways that are very different than someone who aware of and sensitive to that connection. As a result of different dynamics in the motivational system, environmentally related judgments and actions are likely to be different.

As Stern (2005) pointed out, while people tend to avoid "contravening strong personal norms", they do not always behave in accordance with them (p. 10,788). Stern partly attributed this to the influence of habits. Inconvenience that people feel about possible pro-environmental behaviors, including the cost or difficulty of such behaviors may serve as barriers reducing pro-environmental motivation (Bratt et al., 2015, p. 468).

In this context, it is useful to pay attention to "the energy efficiency gap": even when financial incentives are present, many people may "fail to take energy-saving actions that would provide highly attractive returns on their investments of money or time" (Stern, 2011, p. 311). This puzzle is an indication of the complexity of the dynamic motivational system that gives rise to environmental behavior in close connection with contextual factors. As Stern pointed out "the riddle might be solved and the gap narrowed by research that examines the full range of factors that can promote or inhibit behavioral plasticity" (p. 311). One possible factor is the strength of established habits, the protection of which may be constructed and experienced as self-interest. Even when alternative behaviors may be less costly objectively, they may be avoided by certain individuals as unknown, until they become familiar and comfortable. Consistently,

"inertia in favor of maintaining the current way of doing things" may be a barrier against pro-environmental behaviors (Coyle, 2005, p 35).

Applying van Geert's (1993) CDS approach, the motivation for self-interest may have cooperative and/or competitive relationships with the motivation for environmental care and protection, depending on both contextual characteristics and how self-interest is constructed and regulated by the individual. In some cases, the relationship is cooperative: "85% report that they frequently turn off lights and electrical appliances when not in use.... at least part of the motivation is likely environmental" (Coyle, 2005, p. 35). In such cases, both external (i.e., external regulation and introjected regulation) and internal (identified regulation and integrated regulation) motivations may be operative.

This is also consistent with Bentham's (1780/1823) *duty and interest junction principle*. This merging of self-interest with duty is in contrast with the view of Kant who emphasized the intrinsic moral value of actions based on a pure motive of duty (respect for duty), dissolved from concerns of self-interest. This would be environmental duty for its own sake (intrinsic environmental motivation), without any *admixture* of incentives (Kant, 1785/1996). On the other hand, from a developmental perspective these two perspectives are not necessarily mutually exclusive. Bentham's practical perspective can be utilized and implemented for making progress toward Kant's developmental vision of acting from a sense of duty. As both internalization and intrinsic motivation develop through the support for relatedness, autonomy and competence (Deci & Ryan, 2000; Ryan & Deci, 2000), motivation for environmental behaviors can become less reliant on extrinsic reinforcers for self-interest. As a result, internal motivations can become more strongly operative, and environmental behaviors can be more strongly based on respect and care for the environment for its own sake.

In this developmental process, "internalized altruistic concern" (Stern, 2011, p. 306) may strengthen and ERBs may emerge even in the absence of strong and direct increases in self-interest. To the extent that the individual may shift from egoistic to altruistic and biospheric values (Stern, 2005), it may become possible to move from an egocentric to an ecocentric approach (Liang et al., 2018) in one's dynamic system of motivation. Still, in many instances, daily human actions involve multiple motivations, including self-interest and a sense of duty (e.g., duty of caring for the environment), which are likely to co-exist and even cooperate in the emergence of a single action.

## Conclusion

As a complex dynamic system, EM develops iteratively in multiple time scales by building on its own activity of relationships between cognitions and emotions, in connection with dynamically changing contexts. These relationships form specific motivations, such as self-interest and care for the environment, which are meaningful in specific contexts. Out of the operations of and relationships between these motivations, environmentally relevant judgments and actions emerge.

Each new motivational state of the system is a function of its own earlier state. The psychological process of awareness and regulation of self-interest is particularly critical for the functioning of this system and the development of EM. Similarly, environmental identity and duty are important for the emergence and sustainability of pro-environmental behaviors. Both identity and a sense of duty can function as sources of resilience against temptations of self-interest that can otherwise lead to environmentally harmful behaviors.

While reflecting developmental regularities and observing the laws of complex dynamic systems, both short-term and long-term development of EM is individualized based on the uniqueness of each person's motivational state and developmental trajectory, including unique history of encounters with specific environmental and educational contexts.

In the form of motivated judgment and action, environmental behavior emerges out of the inherent activity of the dynamic motivational system, in close connection with contextual factors. Chief among these factors is support for autonomy, relatedness and competence in EM-related contexts. Thus, educational programs and policy initiatives that cultivate a sense of ownership and self-regulation, meaningful interpersonal connections, and mastery are more likely to facilitate pro-environmental behaviors and the development of EM, particularly in terms of the experience of more internalized environmental motivations. As repeated activities in the short-term time scale serve as building blocks for the long-term development of EM, sustainable pro-environmental habits can grow and operate as integral aspects of the development of environmental identity.

Future studies that examine EM as a motivational system can further explicate the emergence of pro-environmental behavior. Studies that carry out in-depth and detailed explorations of individuals' motivational activity over time will be particularly useful for illuminating the individualized developmental process of EM.

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**Data availability** No datasets were generated or analyzed during the current study.

## Declarations

**Conflict of interest** Ulas Kaplan declares that he has no conflict of interest. Wei-Ta Fang declares that he has no conflict of interest.

**Ethical approval** This study has not received any funding, except a teaching-unit reduction through the Literacy Research Fund. And no human subjects participated.

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