

Are you acting sustainably in your daily practice? Introduction of the Four-S model of sustainability

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ABSTRACT

Young generations worldwide are not only drastically calling for a more sustainable future, but for having a future at all. In this conceptual article, we pursue the question of how we can make this happen, and argue why it is up to every individual to do so. Based on the rationale of the four-c model of creativity, we argue for four levels of individual sustainability actions: mini-s, little-s, Pro-S and Big-S. Mini-s actions are intrapersonal and represent a core element of individual learning about sustainability. Little-s actions are more interpersonal and demonstrate, on average, a higher reach and impact than mini-s. Pro-S stands for professional actions and solutions. These types of actions are interpersonal and extend their reach and impact beyond a small group of people. They usually need some degree of expertise to achieve a greater reach and impact. Big-S relates to big actions with the highest reach, impact, novelty and usefulness. They refer to solutions that are likely to change how we generally relate to a given product or category and cause a drastic change in our lifestyle. We discuss each action category with examples and outline how these actions may support different sustainability solutions. For this, we search relevant literature on current measurement and conceptual approaches and on specific solutions and take the case of a comprehensive economic approach, steady state economy. Also, concrete levels, conditions, goals, attributes, creativity degrees, profits, motivations and bottom-up principles with examples of application are introduced.

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1. Introduction and motivation

It is indisputable that we are facing the most difficult sustainability crisis of all times. Climate change, poverty, pollution, water scarcity, overpopulation, and overconsumption are some of the challenges that keep scientists from a wide range of research disciplines such as ecology, biology, chemistry, economics, sociology, management, creativity, and innovation awake at night.² It is also undeniable that we should be contemplating drastic lifestyle changes as potential solutions if we would like to stop or reverse the environmental destruction of our planet (see Magnus-Johnston,

2016 for a recent discussion).

In addition, we have unexpected and unpredictable challenges which affects not only certain countries or regions but the whole world. For such situations, traditional approaches from management science or engineering can only help to a certain extent. Creative, innovative and at the same time sustainable solutions are needed, and this in a very short timeframe. This idea is outlined in the so-called VUCA framework, which yields to support organizations in identifying, mapping, and preparing in regards to volatility, uncertainty, complexity, and ambiguity in their industry (Bennett and Lemoine, 2014).

Hence, one might wonder how interdisciplinary approaches coming from creativity, innovation, and sustainability might shed light on these important challenges? The reason: creativity and innovation research can provide an interesting and different angle on sustainability problems or solutions. Moreover, sustainability concerns and natural bounds (Jackson, 2017) represent boundary conditions and goals for creative and innovative products and solutions. Thus, we might ask ourselves, what do creativity,

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² Washington and Twomey, 2016 for a discussion of different sustainability issues and potential solutions.

innovation and sustainability fields or research areas have in common?

They share a common concern with solving or trying to solve difficult problems by providing original and useful solutions to these problems. The problems in all three fields tend to be a “wicked” type of problems,³ ill-defined, difficult, with multiple solutions, requiring divergent types of thinking (see Guilford, 1967, for the original proposition). The nature of wicked, complex sustainability problems requires solutions with different levels of novelty and usefulness, reach, complexity of implementations, and level of expertise from different actors ranging from laypeople to scientists. Hence, we posit that sustainability solutions, and to some extent problems, need to be divided into different categories to help organize our current knowledge and direct future research efforts.

Consequently, the purpose of this article is to provide a theoretical framework with a conceptual model called the Four-S model - four levels of solutions or actions - inspired by a creativity model called the Four Cs with the intention of motivating researchers to conduct more research on sustainability solutions and actions at different levels. In order to reach our research goals, we briefly review basic concepts coming from creativity, innovation and sustainability, emphasizing their commonalities. After presenting our model, we make use of relevant examples from the literature to illustrate the applications of our model.

With this, our introduced conceptual framework adds to our general understanding of sustainable development and sustainability. First, we provide a unique differentiation of actions, so from the very personal level (individual engagement), to one for a whole society (institutional engagement). From our understanding, this is very important for sustainability theory and practice. So far, most research is either on the individual or the general level. But to address the aforementioned challenges, an integrated view is crucial. In this context, we see our introduced framework as a starting and not an endpoint. We hope to encourage other researchers in the field to continue with empirical studies, further investigating how to foster sustainable development and sustainability. Second, we highlight that the sum of all activities has the potential for a better future. For this, we highlight the cumulative impact of the four-S of sustainability levels. Third, we do not only introduce a theoretical framework, but also its implementation. For this, we discuss levels, conditions, goals, attributes, creativity degrees, profits, motivations and bottom-up principles with concrete examples of application. Finally, we highlight key components of a steady state economy as an overarching goal for a sustainable development: population growth, consumption, work flexibility, wealth distribution and technology investments.

Before we continue, it is important to mention what this article does and does not cover. The two authors define themselves as social scientists conducting research on creativity and innovation with important implications for different research areas, including sustainability (Brem et al., 2016). Our educational, research, and private sector background comes mainly from psychology, consumer behavior, business, and innovation management. Consequently, our article offers a perspective heavily influenced by creativity, innovation, business and management. As a result of our background, our propositions are short on specific knowledge from disciplines such as ecology, biology, environmental sciences, demography, environmental engineering, or physics, to mention a few disciplines that are making significant contributions to different sustainability-related problems and solutions. Ideally, this

article will help to foster such an academic discussion in the future that includes these fields.

2. Theoretical background: creativity and innovation

Creativity scholars tend to agree that solutions to problems need to be at least novel and useful (Kaufman et al., 2017) in order to be creative. In order to call it innovative, such novel and useful solutions need market acceptance (Von Hippel, 1988). The type of problems and solutions examined by creativity scholars have implications for many different disciplines, including education, business strategy and management, engineering, product design and development (Kaufman et al., 2017). Based on this definition, creativity scholars have had to face the challenge of investigating creative solutions at different levels. Whereas there is no debate about the scientific creativity of geniuses such as Marie Curie, Charles Darwin, Grace Hopper, or Thomas Edison, there is more controversy about the creativity of professionals, laypeople and children. For example, it is difficult to classify a brief spark of insight that a layperson would have even though it might make a significant contribution to his or her learning process (Beghetto and Kaufman, 2007).

The Four-C model of creativity was developed in order to conceptualize creative ideas and actions using a wider range that includes solutions that have changed the world and solutions that one child might find personally novel, useful and valuable (Beghetto and Kaufman, 2007; Kaufman and Beghetto, 2009). Specifically, the Four-C model of creativity suggests the classification of creative solutions into four categories: Big-C, Pro-C, little-c and mini-c. This model is developmental and non-linear.

The model starts with Big-C creativity. This type of creativity involves solutions or products that have received worldwide recognition and were acknowledged as ideas that have changed an entire field of study. One such example would be the theory of evolution proposed by Charles Darwin. Pro-C creativity involves solutions or products that have received significant but not worldwide recognition. These solutions are acknowledged as ideas that have had a significant impact on some segments of society. For example, in the 1970s companies started having a commercial battle on bottled water. Companies persuaded consumers that it was not safe to drink tap water. This idea has made bottled water the most sold beverage in the world with important, arguably positive health benefits in places where safe drinking water is not available – namely developing countries, but also with important, negative environmental consequences.⁴ Yet, we would not consider the idea of selling bottled water as something that received worldwide recognition for its originality or usefulness.

Little-c involves creativity that is shared with others, but that has, relatively speaking, low impact. It is a form of creativity recognized by others, but its impact does not go beyond this small group of people. Last, mini-c creativity involves intrapersonal forms of novelty and usefulness that represent brief or momentary sparks of creativity that are only meaningful at the personal level. It is suggested that mini-c creativity plays an important role in the learning process, hence from an intrapersonal perspective, it is very meaningful even though it might not be recognized by others as something novel, useful or valuable (Kaufman and Beghetto, 2009). Hence, it is the type of everyday, personally meaningful creativity.

While the Four-C model, like any conceptual model, has its shortcomings, the model has contributed by acknowledging that there are different antecedents and consequences of the different

³ see RitRrel & Webber, 1973, for the original conceptualization of “wicked Problems”.

⁴ See e.g. <https://www.thekitchen.com/a-brief-history-of-bottled-water-228642>.

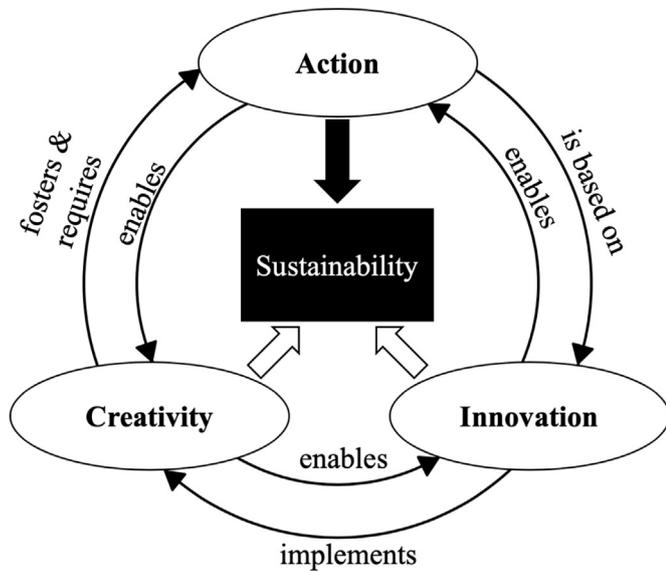


Fig. 1. Proposed useful connections between creativity, innovation, and sustainability.

levels of creativity (Kaufman and Beghetto, 2009), that they can be found in an intercultural context to a certain extent (Puente-Díaz et al., 2016) and that they are also perceived in these gradations by others.

Consistent with the notion that solutions need to be novel and useful in order to be creative, innovation involves the successful implementation of these novel and useful ideas (Brem et al., 2016). Thus, innovation needs novel and useful solutions to be implemented successfully if one wishes ideas to reach their potential (Von Hippel, 1988). It has been suggested that in a business environment, for example, the correct selection and implementation of ideas tend to pose more challenges than the actual generation of ideas (Terwiesch and Ulrich, 2009). If this is correct, then it makes sense to examine possible antecedents and consequences of idea generation, selection and implementation, given that they might differ. Even though creativity and innovation have their own scientific literature streams, journals and conferences, there have recently been stronger efforts to point out the commonalities between creativity and innovation (Brem et al., 2016), including entrepreneurship (Shalley et al., 2015). Now, we posit that there are useful connections between creativity, innovation, and sustainability, as shown in Fig. 1 and seek to examine how they could influence each other, the core of our conceptual proposition.

3. Theoretical framing: sustainability and its measurement, specific and broad solutions

Multiple disciplines are paying close attention to sustainability issues, including ecology, biology, chemistry, environmental engineering, product design, business, management, economics, marketing, creativity, and innovation, just to name a few (Kopnina and Blewitt, 2018). This seems convincing given that sustainability has broad implications and is such a complex issue that must be tackled from different angles. Sustainability scholars tend to agree that the most difficult and crucial problems faced by humanity are overpopulation, overconsumption, climate change, pollution and the excessive use of non-renewable resources (Washington and

Twomey, 2016).⁵ These difficult problems are considered so-called wicked problems, a term coined by public administration scholars (see Rittel and Webber, 1973) and recently used by business researchers trying to posit the implications of management for sustainability (e.g., Etzion, 2018; George et al., 2016). The most dominant defining characteristic of wicked problems is that they do not have a single, clear solution. A wicked problem is similar to an ill-defined, divergent type of problem that, moreover, cannot be solved by a single solution. Wicked or divergent thinking problems tend to be multi-level in nature, requiring imperfect approximations to solutions at the individual, group, societal, organizational, institutional, or governmental level in order to come close to a possible, imperfect solution.⁶ Another important academic term of these days describing such wicked problems is VUCA, which refers to situations of Volatility, Uncertainty, Complexity, and Ambiguity, where multiple options with unpredictable consequences and unstable information meet (Mack and Khare, 2016).

The major sustainability problems faced by this planet and its inhabitants radically contrast with the guiding idea and principle of endless economic growth at the country, company, and personal level and the assumption that economic growth leads to prosperity (Daly, 1991; Jackson, 2017; Victor, 2019). The problem with this idea is that environmentalists see it as a dangerous illusion that has caused already significant environmental and social damage (Washington and Twomey, 2016). Consequently, the economic goals of endless continuation and indefinite growth have negatively influenced individuals, communities, employees, companies, and government officials (Victor, 2019). Defenders of economic growth sustain that technology would eventually lead to more efficient means of production, reducing environmental damage. Yet, most sustainability scholars claim that this idea is wrong and that we need to change our definition of prosperity, leaving out the aspiration of continuous economic growth (Jackson, 2017). The problem is that the goal of economic growth is so engrained in our society that we would require drastic changes and solutions. Hence, it is not surprising that the young generation starts demonstrating for their rights all over the world, as they see their (and their kids) future in danger. But how to solve this complex issue?

Under this background, we conducted a limited search of the literature on sustainability focusing on three major themes: 1) measurement and conceptual approaches to different sustainability challenges,⁷ 2) proposed solutions to popular problems, and 3) broader economic solutions. One can find hundreds of empirical and conceptual articles focusing on these three themes. Our literature review is not comprehensive but rather illustrative.

3.1. Measurements and concepts of sustainability

Given the broadness of the scope of the concept of sustainability, it is not surprising to find a wide variety of research themes, frameworks, measurement approaches and solutions, ranging from educational issues to corporate culture and the sustainability of supply chains. For example, recent research on education about sustainability posits its important role if we are to generate effective solutions (Leal-Filho et al., 2018). Transformation should play a prominent role if sustainability is to be fully integrated into the curricula of higher education. In order to reach transformation, personal values, ethics and reflection are important for the learning process to occur even if they do not represent actions with

⁵ For further details about the UN Sustainability Goals, this official website is recommended: <https://sustainabledevelopment.un.org>.

⁶ An example of an approach to solving wicked problems is the website <https://www.xprize.org>. Here the so-called crowd can participate in problem-solving, from laypersons to experts in certain fields.

⁷ We thank one anonymous reviewer for this suggestion.

significant impact or reach. In addition, these actions would be fruitless if university officials, faculty chairmen' and professors do not support the integration of sustainability dimensions in their programs and classes. Hence, actions are required at the intrapersonal and interpersonal level. The important role of education and learning is further emphasized by scholars positing it represents a great challenge to implement correctly and successfully environmental programs designed by experts, even though they might be based on the best possible science (Chapman, 2016).

Companies represent a key player if we expect to have a healthier planet (Etzion, 2018). Companies are complex social systems, whose main goal is profitability, not sustainability. An interesting article suggests two important shortcomings of related literature to this phenomenon (Staniskiėne and Stankeviėciute, 2018). First, the social dimension of sustainability has not received the same amount of attention as environmental or economic sustainability. Hence, the construct of social sustainability lacks conceptual and operational clarity. Second, when the social dimension of sustainability is measured, it rarely considers the employees' perspective, which is troublesome since employees are some of the most important stakeholders in companies. A recent investigation tried to address these limitations by conducting a mixed-design empirical investigation. Results showed the presence of six dimensions of social sustainability: employee participation, employee cooperation, equal opportunities, employee development, health and safety, and external partnership, illustrating that companies have multi actors or stakeholders which might have conflicting goals (e.g., shareholders vs. employees). This article suggests a measurement approach to examine sustainability from the employees' perspective.

Islam et al. (2019) offer an interesting perspective on Corporate Sustainability (CS). According to these authors, Corporate Culture (CC) regarding sustainability is crucial to improve CS performance. Hence, it needs to be considered when assessing CS performance. Regardless of the level of innovation or implementation of technological advances, it would not significantly improve CS performance unless CC is aligned with these advances. Hence if a company is to improve its CS performance in all three suggested dimensions: economic, reduction of environmental impacts and social welfare, it needs to influence its corporate culture. Employees need to endorse and internalize the values suggested by their corporate culture. Companies need to assess the environmental needs of communities and measure how their operations influence the environment and social welfare of the community, probably requiring complex actions.

Supporting the role of multiple actors in most assessments, programs, and initiatives, Silva et al. (2019) examined whether stakeholder's expectations are met by the current developments on the measurement of performance and assessments of sustainability. The main finding is that stakeholders are not currently satisfied, but this dissatisfaction depends on the role played by each stakeholder. Specifically, the literature review identified six stakeholders: standard setters, process executors or enablers, impacted stakeholders, information providers, addresses, and decision-makers. One key difference between actors is their level of reach of their potential actions. Addresses, for example, might include consumers or CEOs. Consumer needs might tap into personal decisions to invest or support a given company or buy a product. Conversely, what a CEO wants in terms of the measurement of performance of sustainability might have wider implications for society, for a community as a whole. Hence the types of actions or solutions that might come in terms of assessment or performance of sustainability might range from personal decisions to solutions impacting entire communities or multiple countries, lending evidence to the importance of breaking down solutions to examine the

facilitators and inhibitors of sustainability at different levels of analysis.

Illustrating the complexity and multilevel nature of sustainability themes and problems, a recent review focused on assessing the approaches used to measure sustainability performance in supply chains (Qorri et al., 2018). After reviewing more than 100 articles, the authors concluded that the literature was scattered, fragmented and incomplete and proposed a conceptual framework to measure sustainability performance in supply chains of companies. This line of research would include solutions and actions at multiple levels with important implications given that 20% of global greenhouse gases emission come from 2500 companies and supply chains are the most important contributor (Dubey et al., 2017).

Cagno et al. (2019) make a very important claim: sustainability performance at the industry level cannot really improve if it is not measured properly. Hence, they conducted an extensive literature review to develop a measurement framework capable of assessing industrial sustainability along three pillars: economic, environmental, and social. Results showed that current measurement systems were not holistic enough, lack clarity regarding the most important indicators and how many should be assessed and were difficult to implement. To address these gaps, they developed a new measurement system. Preliminary empirical findings suggest that the new framework is comprehensive enough, useful and easy to administer, lending evidence to its potential relevance across different countries and industries. Comprehensive measurement systems such as the one just described and its potential for developing solutions would require breaking down the problem into different levels of actions and solutions. Hence, companies would need to develop and adopt cleaner modes of energy production, socialize sustainability values as a core company value and assess how employees adopt and internalize these values to become part of their eco-friendly identities.

So overall, many different aspects in terms of sustainability measurement and management must be considered (see Table 1). Another level of complexity is added through different research methods.

From this limited review of the literature, it is clear that measurement and conceptual approaches are needed at different levels of analysis and including multiple actors. The challenges range from educating future professionals about the importance of sustainability to designing supply chains that are sustainable. A similar pattern is likely to emerge if we pay attention to specific solutions to popular problems such as food waste and textile reuse and recycle. This is addressed in the following

3.2. Specific solutions: the case of textile reuse and recycle

We use a similar approach to find specific examples of solutions. We searched the literature for articles, illustrating relevant and current themes in sustainability with their respective solutions (see Geissdoerfer et al., 2018; Sandin and Peters, 2018; Schanes et al., 2018 for three recent examples). We choose textile reuse and recycling (Sandin and Peters, 2018) as a sustainability problem with its respective propositions to illustrate the complexity of the problems faced by society and to show how a multi-level approach is needed.

Regarding textiles, at the highest level of creativity and innovation, we need environmental scientists working together with chemical engineers to try to develop the most environmentally friendly textiles, that is, we need complex actions and solutions provided by experts. In addition, companies would need to rethink and revise their business models. A traditional business model relies heavily on sales growth (Jackson, 2017) which might be

Table 1
Selected trend topics in sustainability measurement and management.

Topics	Key Performance Indicators	Circular Economy	Responsible Research and Innovation	Eco-Innovation	Intercultural differences
Contradictions	Individual vs. Group Behavior	Intrinsic vs. Extrinsic Motivation	High regulation vs. low regulation	Profit orientation and growth vs. steady state economy	Consumption vs. sustainability
Methods	Qualitative Research	Quantitative Research	Field and Lab Experiments	Longitudinal Studies	Theory development

hindered if textile reuse and recycling are implemented widely. At the community, group or societal level, we would need efficient ways of collecting clothes either for reuse or recycle so they do not end up causing more damage to the environment. In addition, and more importantly, we know that clothes signal status (Mears, 2019) and societies pay attention to and praise status (Von Hippel et al., 2014). Group and cultural norms might have to change in order to praise and value environmentally friendly actions. Hence, instead of assigning high status to individuals who constantly wear new clothes or have more clothes than needed, societies would have to praise individuals who reuse, lend, borrow and donate clothes in order to go from a conspicuous consumption mindset to a more frugal mindset. Last, we would need individuals and consumers to value and care for these practices. Currently, we care more about our relative standing and position to signal status, especially men, and attract potential mates (Buunk et al., 2014; Frank, 1999). We need individuals to adopt frugal lifestyles, so this simplicity could become a sign of status, a sign of commitment to a bigger cause, which, hopefully, some might find attractive as opposed to the usual ways of signaling status, conspicuous consumption. It is within the complexity just illustrated that we posit that it would be beneficial to frame and organize problems and solutions by their different levels of actions, their reach, and whether they are more interpersonal or intrapersonal.

In times of crisis, the textile industry can also change into a different role. Producers like Zara, Gucci, Yves Saint Laurent, Mango and LVMH (owning brands like Dior, Fendi, Louis Vuitton) changed from their initial business model of fashion to produce personal protective equipment like masks or hospital equipment (Bramley, 2020). This is an example of creative behaviors from famous designers and employees.

3.3. Comprehensive solutions: A steady state economy

Even though we see value in the discussion of current measurement and conceptual approaches and specific solutions (section 3.1 and 3.2), the potential for substantial change is limited if we do not address economic issues. We see a key solution in changing our economic goals to a steady state perspective, in which the economy is seen just as a part of a broader environment that needs to be prioritized (Diesendorf, 2016). The steady state economic approach shares some similarities with other approaches such as degrowth, circular economy, green economy, and sharing economy (Kopnina and Blewitt, 2018). One of the core characteristics of these approaches is that they require a high degree of behavioral change from laypeople. Thus, individuals need to learn about the environmental challenges and the individual behavioral changes needed to overcome them. We prefer the steady state economic approach because it is more comprehensive in the sense that it covers the much needed but controversial issue of overpopulation. In order to reach a steady state in economic terms, we need change at different levels of analysis, including individuals, consumers, communities, businesses, local government officials, and world leaders. We also need changes ranging from beliefs and attitudes to complex actions, plans, and technology developments. Yet, more importantly, we need to envision human prosperity and well-being

without economic growth (Jackson, 2017; Victor, 2019). This can only be achieved if we conceptualize sustainability issues and the goal of prosperity without growth as multi-level phenomena. This is key since a meta-responsibility is easy to postulate (e.g. “use fewer resources”), but difficult to translate in each individual’s daily practice (e.g. “use the train instead of a flight”). In addition, in industry and business practice, responsibility is usually shared by many different people (Timmermans et al., 2017), the same is true for a whole society. However, once a meta-responsibility is broken down to specific actions, it can be turned into practice. This phenomenon can be observed with many general concepts related to sustainability, like Responsible Research and Innovation (RRI) (see Stahl et al., 2017). So, if we know more about our own actions which contribute to a positive meta-responsibility, this will be eventually good for the whole society. For this, it is important to link responsibilities from all different levels with concrete actions on an individual level. It is crucial to translate these creative sustainability ideas into concrete actions, facing an important challenge of implementation.

Against this background, we propose a new model called the Four-S model of sustainability solutions or actions.

4. Introduction of the Four-S conceptual model

Our conceptual model makes the following assumption: given the complexity of most, if not all, sustainability issues, problems and solutions, it might be wise to adopt a conceptual model that breaks down the solutions or actions needed to different levels. We refer to this model as the Four-S model, in which S stands for solutions: mini-s, little-s, Pro-S and Big-S.

The mini-s stands for mini solutions or actions. Environmental degradation was probably caused by several factors, but it is indisputable that one of the most important ones was human activity (Kopnina and Blewitt, 2018), rooted on an anthropocentric position (Shoreman-Ouimet and Kopnina, 2016). Consequently, in order to solve some of the environmental problems we face, we need individuals to understand how their own decisions and behavior influence the sustainability of this planet and how their decisions and behavior today is jeopardizing the sustainability of this planet for future generations. A starting point might be for individuals to understand and internalize the right values regarding the relationship between humans, other living species and the ecosystem (Shoreman-Ouimet and Kopnina, 2016). Individuals are thus required to possess the right moral (Grasso and Tábara, 2019) and ethical values (Washington and Twomey, 2016), based on an eco-centric worldview, contributing to an overall meta-responsibility for our planet. Specifically, individuals would need to adopt a life-respecting, greener moral perspective (Rolston, 2012). Moral values could function as a trigger to guide decision making among different actors, including laypeople, consumers, politicians, inventors, and business people, among others. Moral values might also help to eliminate some of the cognitive barriers documented in order to adopt and endorse sustainable attitudes and behaviors (Trudel, 2018). It is important to mention that mini solutions or actions might represent a necessary yet insufficient condition in order to achieve the much-needed change.

However, mini solutions or actions could represent an integral part of the learning process where humans learn to establish a new relationship with the environment. The relevance of establishing a new relationship with our ecosystem becomes even clearer if we accept that sustainable behavior needs to become a habit and not a one-time quick solution. In other words, if we are to drastically stop, change and even reverse some of the environmental damages we face, we need to observe significant and sustained changes in the behavior of most individuals. This is an important aspect since these mini-s actions usually happen in a private environment. So in most cases, nobody will notice these actions and/or compliment the person who did this action. In the worst case, this might even lead to a reaction where individuals think that their contribution is too small to trigger any change in the big picture. Hence, for mini actions, intrinsic motivation is a core component, doing sustainable actions for the sake of doing them.

Even though we have focused on values, mini solutions or actions could also include attitudes, goals, self-knowledge, and identities, among others, that would facilitate the adoption of sustainable behaviors. These greener or sustainable behaviors would be relevant across different roles that individuals play in their lives including their role as consumers, employees, employers, investors, politicians, community members, and scientists, among others. Hence, we could conclude that mini solutions or actions have a limited reach and impact and tend to be intrapersonal. Impact and profit of mini-s will therefore emerge on an individual level. The degree of creativity and innovation tend to be low and intrapersonal as well. Deciding to cut the use of one's car in half each weekend does not represent a groundbreaking action or solution, but it does represent an important step toward having a more sustainable mindset - even more, if you multiple these individual actions to a whole city, county, country, or continent.

Little-s stands for little actions or solutions. Little actions are more interpersonal and have, relatively speaking, higher reach and impact than mini actions. They also tend to be more original and useful, have higher creativity than mini actions. Little actions could start with values, as the example given in mini-s, but individuals would feel the need to go beyond the self. Examples of little actions or solutions could be a person trying to convince her neighbors to go grocery shopping together to use only one car instead of many or a team leader giving an incentive to her team members for getting to work every morning by riding their bikes instead of their cars. Little actions are necessary yet insufficient. They are necessary because it is only through the cumulative efforts of millions of individuals that real change can be achieved. Little actions do not only represent an endorsement of sustainable behaviors but also a model of what these types of behaviors might look like and function as an ambassador of sustainability. In addition, little actions are needed because they can be part of the socialization process of sustainability and part of the development of a culture of sustainability. They have a group-level impact and profits and can therefore be achieved on the social setting or the social milieu of such group. Also, these actions can be framed in a positive way so that people do not only save natural resources but also money. Activities such as these are inclusive as people from all economic classes can participate.

Pro-S stands for professional actions and solutions. These types of actions are interpersonal and extend their reach and impact beyond a small group of people. They usually need some degree of expertise to achieve a greater reach and impact on a regional level.

Any individual, private company or non-profit group trying to develop sustainable programs, products, or services would classify as Pro-S. These actions tend to have a higher degree of creativity and more difficulties of implementation since they involve a bigger and more diverse group of stakeholders.⁸ Thus, the actions need to be novel and useful to have some degree of success, and the implementation part poses similar or even bigger challenges than regular products or services. If a for-profit organization is involved, it needs to have financial sustainability in order to survive and continue serving their customers. Pro actions or solutions might have some degree of involvement from the government, state or national levels in the form of environmental taxes or subsidies to develop sustainable solutions. Given that Pro solutions or actions have a wider reach and impact, they need to have some sort of surveillance and regulation to avoid green-washing efforts. In other words, Pro solutions or actions need to have a higher level of sustainability than previous solutions, otherwise it would not be optimal to adopt them. For-profit companies need to be transparent about the environmental impact of their products and services. For example, when asked how much a smartphone weighs, most consumers would answer around 200 or 300 g, without knowing that when all resource extraction, material processing, distribution, fabrication, retail and disposal are considered, the actual weight of a smartphone is around 500 kg (example taken from Chapman, 2018). Ideally, private companies would need to seek sustainability as an end in itself and not as mean to an end. One major obstacle is that private organizations are not designed to be sustainable but profitable (Etzion, 2018). Yet, pressure from consumers or independent organizations⁹ might be able to change this outlook, and in the future, they need to be sustainable in order to be profitable. Finally, one might argue that such actions are preferably taken by people with a middle or high income, who can afford better to live sustainably. For instance, with changing a gas car to an electric car, which is mostly still much more expensive worldwide. On the other hand, richer people also contribute less to sustainability in general since they e.g.:

- fly more often and larger distances,
- buy more clothes and other consumer products,
- live in bigger houses and most often in their own house,
- have a car or more than one; use public transport less; and at the same time, poor people
- have less electronic devices,
- re-use and repair things more often than to buy something new,
- and (especially in developing countries) eat less meat, eat local food, grow their own food, etc.

Finally, to stay with the earlier introduced example, one can also argue that an electric car is not necessarily sustainable looking at the resource and energy consumption for producing it especially concerning the battery. If everyone changes to electric cars, the power that needs to be produced is as dangerous to the environment as the gases coming from combustion engines. So after all, not using a car at all, would be the right thing to do.

Last, Big-S stands for big solutions or actions. Big actions have the highest reach, impact, novelty and usefulness. They are solutions likely to change how we relate to a given product or category and are likely to cause a drastic change in our lifestyle. Big solutions also require a great deal of expertise from the creators (see Hawken, 2017 for a collection of solutions to tackle global warming). It is also

⁸ see Chapman, 2016 for a discussion of challenges of implementation in sustainability programs and Contreras-Lisperguer et al., 2017 for a specific example of the challenges of implementing solar photovoltaic technology.

⁹ See e.g. <https://www.businessroundtable.org/business-roundtable-redefines-the-purpose-of-a-corporation-to-promote-an-economy-that-serves-all-americans>.

Table 2
The Four S's (four levels of solutions or actions).

	mini-s	little-s	Pro-S	Big-S
Level	intrapersonal, individual	Interpersonal	interpersonal, extended reach	Societal
Conditions/Requirements	• understand/internalize right values	• influence ambassadorship	groups, • expertise • larger groups	• great expertise • great sacrifice (laypeople)
Goal	• moral change	• endorsement of sustainability • socialization process • culture of sustainability	• financial sustainability • novel, useful actions • professional sustainability	• highest outreach groups • highest novelty, usefulness • change of lifestyle
Attribute	individual impact	group-level impact	regional-level impact	global impact
Degree of creativity & Innovation	low, intrapersonal	Medium	higher, difficult implementation	highest, breakthrough
Profit	individual level	group level, social milieu	regional level	global level
Driving motivation	Intrinsic	intrinsic and extrinsic	intrinsic and extrinsic	Intrinsic
Bottom-up principle	individual change of attitude/mindset	communal endorsement of value and change	institutional implementation of (drastic) solutions	worldwide achievement of desired outcomes

Table 3
Exemplary actions for each sustainability level.

Dimension	mini-s	little-s	Pro-S	Big-S
Action examples	<ul style="list-style-type: none"> • Having less car rides • Using trains where possible • Not throwing away waste while hiking and collecting others' waste • Usage of cotton instead of plastic bags • Buying only seasonal and regional products (preferably organic grown); eat less meat 	<ul style="list-style-type: none"> • Moving to plastic-free at the local sports club • Carpooling at school • Having skype meetings instead of personal visits • No to-go cups at universities anymore • Recycling boxes in universities 	<ul style="list-style-type: none"> • Political influence with regulations • Investment into sustainable companies • Changing car fleet to electric cars • Initial development of new technologies for water treatment • Collecting waste countrywide 	<ul style="list-style-type: none"> • Regulations • Implementation of new technologies like ocean waste cleanup • New ways of living, e.g. underground • Development of new transport systems like beaming

likely that Big actions require a great deal of sacrifice from laypeople when adopting these solutions or engaging in these types of actions. Technological developments on greener means of energy production would be examples of Big solutions likely to allow profit and impact on a global level given the right conditions. An overview of the Four-S of sustainability is additionally provided

in Table 2. Similarly, Table 3 shows examples of actions at the four different levels of our conceptual model.

As mini actions can be achieved with relatively low levels of individual effort, one's mindset toward them might lead to a surprisingly small individual state of behavioral motivation for people not being able to see a great personal impact. But their cumulative impact, on the other hand - by combining all these individual small steps – can lead to a strong and prosperous effect. While the necessary effort to be put into action in order to achieve further goals in little-, Pro-, and Big-S grows extensively, their cumulative impact on personal levels is likely to be more or less moderate, but nevertheless very effective through their higher outreach and professionalism. These relations are drafted in Fig. 2 below within an axis diagram showing effort above the cumulative impact of the four-S of sustainability.

Why do we need these Four-S model? The wicked problems and the potential solutions require changes at different levels, beyond the known political ones (“top-down”). We also need actions from a bottom-up principle. Individuals must change their attitudes and beliefs (mini-s), communities might need to endorse and value some type of changes or programs (little-s), governments, companies, and institutions might need to develop, endorse and propose drastic solutions (Pro-S) and last, worldwide associations or multi-country pacts might be needed in order to achieve the desired outcomes (Big-S). Consequently, these four levels vary in terms of their reach, impact, whether the solutions or actions are intrapersonal or interpersonal, that is, whether they extend beyond the self and their levels of creativity and innovation required. The value of this model is based on the proposition that if the cumulative effect of each individual's action has led or caused devastating effects, it is also likely that meaningful solutions can only be reached by the cumulative effect of each individual's sustainable action.

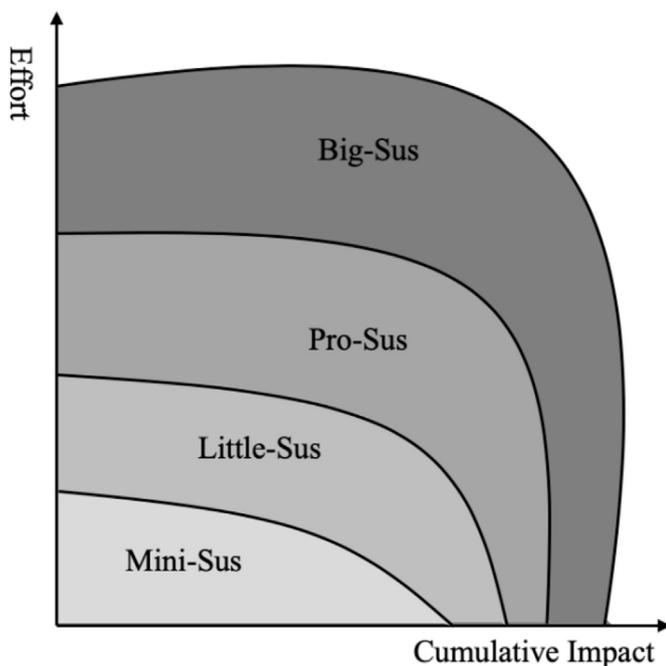


Fig. 2. Effort above cumulative impact of the four-S of sustainability.

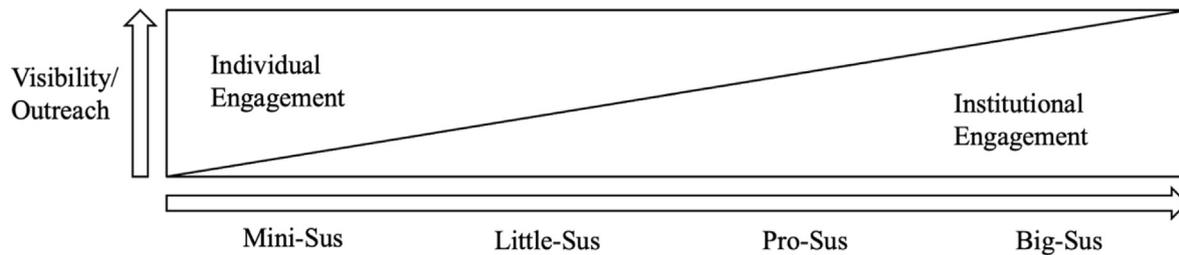


Fig. 3. Shares of individual and institutional engagement in visibility/outreach.

Fig. 3 shows the visibility and outreach of individual engagement (intrapersonal to interpersonal) on one side and institutional engagement (group/regional level to global level) on the other side among the different S-levels of sustainability action.

To illustrate the value of our conceptual model, we work out an example involving a recent simulation of how a steady state economy would look like and the required changes in the behavior and assumptions of all its stakeholders (Turner, 2011, 2016; Victor, 2019). We see the need for using as an example a comprehensive solution to clearly illustrate the applicability of our model.

5. A long term vision for sustainability: A steady state economy

A steady state economy approach represents the most comprehensive solution to our current environmental crisis (Daly, 1991). The steady state economy approach suggests the following components to reach an overall solution: 1) stabilizing population growth, 2) decreasing consumption, 3) increasing work flexibility, 4) redistributing wealth, and 5) increasing investment in new technologies (Turner, 2016). We will now review specific details of each part of the comprehensive economic approach of steady state economy, emphasizing the connections with our conceptual model.

According to some experts, this planet could have 9 billion people by the year 2050 (Engelman, 2016). This number of people would put too much stress on the environment if we continue to live this way, leading to negative, permanent consequences. Hence, if we are to stop or at least attenuate the environmental crisis we are facing, we need to stabilize population growth (Daly, 2015; Washington, 2015). Several measures have been proposed, including giving universal access to contraceptives, providing women opportunities for education, eliminating gender bias toward women, and including sex education for men and women (Engelman, 2011, 2016). Besides governmental actions (Pro-S), individuals would need to internalize the value and goal of having fewer children. This would entail mini actions in order to develop the appropriate beliefs and attitudes toward having children, having protected sex, planning pregnancies, among others. Little-actions would also help by providing social and educational support to significant others or members of one's community. It is only through the combination of Pro-, little-, and mini actions and solutions that we could reach the goal of stabilizing population growth. Governments providing contraceptives would not be enough unless individuals have the appropriate attitudes and beliefs toward planned pregnancies. Research could focus on understanding attitudes, beliefs, and goal formation regarding pregnancies and children, especially in countries that have high fertility rates.

It is well-established that valuing material possessions has a negative impact on subjective well-being or happiness (Donnelly et al., 2016). Yet, we continue increasing or at least maintaining

our consumption levels. If population continues to grow, people in poverty continue having the justified need of acquiring material possessions, and the rest of the world maintains its current levels of consumption and material use,¹⁰ the environment would not be able to support this level of consumption (Jackson, 2017). Thus, we need to reduce our consumption levels. Yet, this goal is not an easy one because our current economic system is based on the idea of continuous growth. Governments want their economies to grow in terms of Gross Domestic Product, companies want to sell more goods than previous years, and consumers often equate increasing well-being or being better off with the acquisition of more material goods. Thus, we would need solutions that would challenge our current economic system (Big-S or Pro-S type of measures) and provide workable alternatives. Community leaders would need to socialize the value and benefits of reducing consumption (little-s). Last, individuals would have to change and internalize the value of having less and defining success in terms of having a clear purpose in life and living a meaningful life instead of defining success by the amount of material possession (mini-s). One of the key components to decrease consumption levels is to increase work flexibility, which might entail reducing income.

In economic terms, the steady state solution would only work if unemployment is kept low (Magnus-Johnston, 2016; Turner, 2016). In order to achieve this, the number of hours worked each week would need to be reduced along with the obvious consequence of reduced income (Jackson, 2017; Turner, 2016). Laws would need to support this change and relevant regulations would need to be enforced (Big-S). Companies would need to learn how to manage more employees with reduced working weeks optimally as opposed to less employees working more hours (Pro-S). In addition, employees would need to value the trade-off of having more time to spend with family, friends and relatives but with a reduced income (Little-s and mini-s; Turner, 2016), but also how to manage their own time at work. This is already investigated in literature to a certain extent, for instance, on how creative and routine work should be managed for a highly creative outcome (Brem and Utikal, 2019). Without a reduction in working hours, the level of unemployment would be too high, leading to social unrest.

The goal of continuous growth endorsed by most governments, companies, communities, and individuals had led not only to environmental problems but also to social problems in terms of the distribution of income. For example, in some societies, the richest earners make 500 times more money than the poorest (Magnus-Johnston, 2016). Consequently, ecological economists have suggested setting salary caps and minimum incomes to overcome this situation (Daly, 2013; Dietz & O'Neill, 2013). Given the complexity of this plan, it would likely involve different levels of actions and different stakeholders, incluHuixquilucanHuixquilucand

¹⁰ see Shao et al., 2017 for an example illustrating the relationship between economic factors and material use.

international and local government officials increasing taxes (Big-S or Pro-S), business executives agreeing on establishing salary caps (Big-S or Pro-S), and laypeople's willingness to pay higher, progressive taxes (little-s and mini-s).

Burning fuels (coal, oil, and natural gas) to produce energy has led to devastating outcomes, including climate change and high levels of CO₂ and methane (Hawken, 2017). If we are to tackle this problem, we need to develop, improve, and adopt cleaner sources of energy production. Governments should support research (Big-S or Pro-S), entrepreneurs need to invest their money on green energy production projects (Pro-S), and individuals need to reduce their apathy and be willing to install cleaner sources of energy production in their homes even if newer technology does not initially lead to cost savings (little-s and mini-s). Even though steady state represents an economical approach, its roots come from ecological economics (Daly and Farley, 2010). Hence, this approach stresses not only the need for economic changes but also the idea that nature provides bounds that must be followed.

In sum, the components of a steady state economic approach represent a comprehensive solution that would need different levels of sustainable actions from different stakeholders, supporting the utility of our Four-S model. Knowledge development and programs are needed at the four levels of actions in order to generate novel and useful solutions (creativity) that could be implemented successfully (innovation) in order to have a healthy or healthier environment (sustainability).

Each of us as a citizen is needed in order to make a more sustainable future possible. This individual level is important since all political initiatives of recent decades have shown that it is extremely difficult to motivate people beyond their individual comfort zone. From a practical perspective, the question remains, if and how humans can be motivated to act sustainably. An extreme practical example comes from China: with their social credit system, positive behavior is incentivized, and negative behavior is punished. Here the key question is not a technical one, but an ethical one: how far does or must a society go?

6. Future research

The goals of this article were to show how the fields of creativity, innovation and sustainability could feed each other and learn from each other. In addition, we proposed a model that considers different levels of sustainable actions, which are needed to achieve meaningful solutions. So, what's next?

We certainly know that our proposed conceptual framework is just a starting point, and we would be happy to see an academic discussion about it. Ideally, we might convince one or another colleague to add his or her opinion or even adding empirical evidence which supports or contradicts our proposition. Optimally, concrete Key Performance Indicators would be helpful to measure all sustainability levels of solutions with an empirical approach. This type of research would probably require interdisciplinary work with specialists on individual and group behavior focusing on, for example, mini- and little solutions and management scholars and environmental scientists, focusing more on Pro- and Big Solutions. Across all four levels, researchers would likely find different predictors of sustainable behavior and successful problem solving and obstacles for implementation.

Another avenue for future research might be a detailed discussion with related concepts, such as green or circular economy, eco-innovation, circular economy, and RRI, among others. Further case studies on specific industries could also shed light on different aspects, as well as other methodological approaches, such as lab or field experiments (see Banerjee and Duflo, 2017 for a recent discussion on field experiments and their applications). For instance, it

would be quite interesting to understand what drives our individual motivation. What role does intrinsic and extrinsic motivation play? Do we need more laws and rules, or less? Another area is intercultural differences. In an Asian context, for example, sustainable behavior will be different than in an American one. So the Four-S approach would need to consider such insights.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Alexander Brem: Conceptualization, Writing - original draft, Writing - review & editing. **Rogelio Puente-Díaz:** Conceptualization, Writing - original draft, Writing - review & editing.

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