

*Supplementary Information***Human-Environment System Knowledge: A Correlate of Pro-Environmental Behavior. *Sustainability* 2015, 7, 15510-15526**

**Pablo Díaz-Sieffer <sup>1</sup>, Alexander Neaman <sup>1,\*</sup>, Eduardo Salgado <sup>1</sup>, Juan L. Celis-Diez <sup>1</sup> and Siegmar Otto <sup>2</sup>**

<sup>1</sup> Escuela de Agronomía, Pontificia Universidad Católica de Valparaíso, Quillota 2260000, Chile; E-Mails: p.diaz.sieffer@gmail.com (P.D.-S.); esalgado@ucv.cl (E.S.); juan.celis@ucv.cl (J.L.C.-D.)

<sup>2</sup> Institute of Psychology, Otto-von-Guericke University, Magdeburg 39106, Germany; E-Mail: siegmar.otto@ovgu.de

\* Author to whom correspondence should be addressed; E-Mail: alexander.neaman@pucv.cl; Tel.: +56-32-227-4537; Fax: +56-32-227-4570.

---

Note:

The items listed below were used in the following study:

Díaz-Sieffer, P., Neaman, A., Salgado, E., Celis-Diez, J.L. & Otto, S. (2015). Human-environment system knowledge: A correlate of proenvironmental behavior.

The original Spanish items were translated by a professional translator. Item content should be verified before being used in cultural or geographical contexts other than Chile.

Correct answers are indicated by a black circle.

Please check with authors for a new version of the scale.

**Human-Environment System Knowledge (18 items)****1. What is the greenhouse effect?**

- a) The effect of a greenhouse on plants.
- b) The effect of a greenhouse on the people working in it.
- c) The effect of some gases to cool the atmosphere.
- d) The effect of some gases that damage the ozone layer in the Earth's atmosphere.
- The effect of some gases that trap heat in the Earth's atmosphere.

**2. Which of these gases does not belong to the greenhouse gases?**

- a) Water vapor (H<sub>2</sub>O).
- b) Carbon dioxide (CO<sub>2</sub>).
- c) Methane (CH<sub>4</sub>).
- Sulphur dioxide (SO<sub>2</sub>).
- e) Nitrous oxides (NO<sub>x</sub>).

**3. What is the carbon footprint of a product?**

- a) The total amount of carbon emitted directly or indirectly in the production of the product.
- b) The amount of CO<sub>2</sub> emitted in transporting the product.
- c) The carbon cycle on Earth.
- The total amount of all greenhouse gases emitted directly or indirectly in the production and transporting of the product.
- e) The amount of CO<sub>2</sub> released when a product decays or rots.

**4. What are the effects of global warming?**

- a) Thaw.
- b) Sea level rise.
- c) Drought.
- d) Species extinction.
- All the answers.

**5. Which of these substances is the most harmful to humans?**

- Particulate matter of 2.5 microns.
- b) Sulphur dioxide (SO<sub>2</sub>).
- c) Carbon dioxide (CO<sub>2</sub>).
- d) Nitrous oxides (NO<sub>x</sub>).
- e) Particulate matter of 10 microns.

**6. Which of these forms of energy is conventional?**

- a) Wind.
- b) Solar.
- Hydraulic.
- d) Geothermal.
- e) Maritime.

**7. What is the sector that uses the most water in Chile?**

- Agriculture.
- b) Mining.
- c) Domestic.
- d) Industry.
- e) Forestry.

**8. What is drought?**

- ☒ Availability of water lower than that normally found in a given area.
- b) Areas without water.
- c) Zones where precipitations do not exist.
- d) Water cuts.
- e) Lack of surface water.

**9. Which of the following phenomena is the main cause of the increase in global temperature over the last 20 years?**

- a) The distance that varies between the sun and Earth.
- b) Reduction of the ozone layer, called the “ozone hole”.
- ☒ The increase in the emission of “greenhouse gases”.
- d) The change in ocean currents, such as “El Niño”.
- e) The change in the tilt of Earth’s axis.

**10. Which of these forms of energy is not renewable?**

- a) Solar.
- b) Wind.
- c) Geothermal.
- d) Hydraulic.
- ☒ Nuclear.

**11. What is wrong with carbon dioxide (CO<sub>2</sub>)?**

- a) It damages many plant species.
- ☒ Contributes to the greenhouse effect.
- c) It is poisonous to some small species.
- d) There are fewer in the atmosphere.
- e) Damages the airways of the human being.

**12. Which of the following practices is accepted in organic farming?**

- a) Synthetic fertilizers.
- ☒ Irrigation technology.
- c) Regulators of plant growth.
- d) Pesticides /herbicides.
- e) Genetically modified seeds

**13. Which of the following diseases would not be caused by heavy metals (such as mercury, lead and arsenic) in drinking water?**

- a) Hypertension.
- b) Cancer.
- ☒ Pneumonia.
- d) Chronic headache.
- e) Abortions.

**14. Which is the major cause of pollution of groundwater with nitrates?**

- ☒ a) Agriculture.
- b) Vehicular traffic.
- c) Household garbage.
- d) Mining.
- e) Elimination of wastewater into rivers.

**15. Which of the following gases has greater contribution to the greenhouse effect?**

- a) Methane ( $\text{CH}_4$ ).
- b) Nitrous oxides ( $\text{NO}_x$ ).
- c) Ozone ( $\text{O}_3$ ).
- ☒ d) Water vapor ( $\text{H}_2\text{O}$ ).
- e) Carbon dioxide ( $\text{CO}_2$ ).

**16. What is the impact that detergents have on the environment?**

- a) A positive impact because they release nutrients to plants.
- b) A positive effect because they release gases that decrease the negative impact on the ozone layer.
- c) A negative impact since upon degradation release toxic gases.
- ☒ d) A negative impact because they pollute waters with phosphorus damaging flora and fauna of the aquatic system.
- e) Have no impact.

**17. Which is batteries impact on the environment?**

- a) A positive impact, because when they degrade they release iron it does well for plants.
- b) A positive effect, because when they degrade they release gases that reduce the negative impact on the ozone layer.
- c) A negative impact, because when they degrade they release toxic gases.
- d) Don't impact on the environment.
- ☒ e) A negative impact because they release toxic metals into the environment.

**18. What is the effect of the use of fossil fuels on the environment?**

- ☒ a) The gases released by combustion stop the sun's radiation from leaving the atmosphere, causing the greenhouse effect.
- b) The gases released by combustion decrease the destruction of the ozone layer.
- c) The gases released by combustion stop the sun's radiation reaching the earth, causing the greenhouse effect.
- d) Fuels decrease the greenhouse effect because the gases released by combustion react with  $\text{CO}_2$  molecules.
- e) The gases released by combustion destroy the ozone layer

**Environmental Action Knowledge (17 items)****19. Which action does not help to reduce garbage?**

- a) Read news online instead of buying newspapers.
- b) Buy large containers instead of small.
- c) Use cloth bags for shopping.
- d) Buy clothes and used products.
- Switching to vegetarian food.

**20. Which action does not reduce greenhouse gases?**

- a) Prefer public transport to a private one.
- b) Plant trees.
- c) Save energy.
- d) Heat the house with solar energy.
- Driving catalytic cars.

**21. Which of these products should not be thrown away for being highly polluting?**

- Batteries.
- b) Cans.
- c) Plastics.
- d) Tetra Pak.
- e) Expired food.

**22. Which of these options indicates the amount of water used in the production of a product?**

- a) ISO 9000
- b) Good Agricultural Practices (GAP).
- Water footprint.
- d) Irrigation program.
- e) Water meter.

**23. Which action does not help to save energy costs in everyday life?**

- a) Unplug all electrical appliances.
- Turn off electronic devices without unplugging.
- c) Close the doors and windows when the heating works.
- d) Install solar panels.
- e) Use the lowest amount of light possible.

**24. How one can get companies to reduce their emissions of greenhouse gases?**

- By buying products from companies having known carbon footprint.
- b) By buying fair-trade products.
- c) By preferring local stores.
- d) By buying cheaper products.
- e) By preferring products from smaller companies.

**25. Why one should use the least amount of detergent possible?**

- a) Detergents contain many chlorinated hydrocarbons.
- b) Detergents contain high amounts of heavy metals.
- It is difficult to separate them from the water in a treatment plant.
- d) Detergents are harmful to sewage pipes.
- e) When used in excess, foam is formed causing lower efficacy.

**26. Why is it important to recycle aluminum rather than throw it away?**

- a) Aluminum damages garbage incinerators.
- b) Aluminum emits toxic substances in waste incineration.
- c) The production of new aluminum produces toxic substances.
- The new aluminum production requires very high amounts of energy.
- e) Aluminum is scarce in nature.

**27. Which form of consumption it is not considered ecological *per se*?**

- a) Buying seasonable fruits and vegetables.
- b) Buying local products.
- Buying the cheapest food possible.
- d) Buying food from small vendors or markets, rather than the big supermarkets.
- e) Buying unprocessed foods instead of processed products and/or frozen.

**28. Which of the following actions does not save water?**

- a) Take a shower instead of taking a bath.
- Wash the dishes by hand instead of using a dishwasher.
- c) Wash the car with a pail instead of using a hose.
- d) Reduce the volume of water tank in WC.
- e) Water the garden in the afternoon or evening.

**29. Which of the following waste is not biodegradable?**

- a) Egg shells.
- b) Waste fruit.
- c) Waste of coffee.
- Waste from electronic equipment.
- e) Newsprint.

**30. How much water is used in a shower about 5 min?**

- 80–120 liters.
- b) 700–800 liters.
- c) 15 to 15 liters.
- d) 300–500 liters.
- e) 1000–5000 liters.

**31. How the use of detergents can be reduced?**

- a) Washing sweatshirt and trousers after being used for a day.
- Sorting sweatshirt and trousers after being used for a day.
- c) After using for a day, wash trousers and sort sweatshirt to use them once more.
- d) After using for a day, wash sweatshirt and sort trousers to use them once more.
- e) Buying the cheapest detergent.

**32. How can one more efficiently use paper?**

- a) Bury it in the ground.
- b) Collect used paper and deposit it in the landfill.
- c) Collect used paper and then burn it in a bonfire lit especially to get rid of it.
- Collect used paper and then use it for roasts or to light the wood stove or wrappings.
- e) Buying the cheapest paper.

**33. Are there advantages in buying locally made products over imports?**

- a) There are no advantages if they are of equal quality.
- There are advantages, because this will generate lower emissions of greenhouse gases.
- c) There are advantages because these products cause less damage to the ozone layer.
- d) There are advantages because the products that come from far away arrive at their destinations with reduced quality.
- e) There are no advantages because the production process is the same.

**34. What action does not help the sustainable development?**

- a) Take shorter showers.
- Buy latest technology's products.
- c) Avoid plastic bottles.
- d) Separate waste for easy recycling.
- e) Use public transport.

**35. What action does not help to reduce gas consumption?**

- a) When cooking or heating water to cover the container.
- b) Use electric heating.
- c) Take shorter showers.
- d) On hot days take showers with cold water.
- Leave the water heater in on position in order to save time.

**Environmental Efficiency Knowledge (20 items, used only in the pilot questionnaire)**

**39. What is the appliance that consumes more energy?**

- ☒ TV.
- b) Washing Machine.
- c) Dishwasher.
- d) Fan.
- e) Stereo.

**40. Which food causes more CO<sub>2</sub> emissions per kilogram produced?**

- ☒ Beef.
- b) Fish.
- c) Fruits.
- d) Dairy.
- e) Vegetables.

**41. How much less do LED bulbs spend compared to conventional bulbs?**

- a) 30%
- b) 45%
- c) 70%
- ☒ 80%
- e) 100%

**42. Which of these wastes has high degradation time?**

- a) Tetra Pak.
- b) Cigarette butts.
- c) Drink cans.
- d) Corks.
- ☒ Glass bottles.

**43. Which of the following packs emit less CO<sub>2</sub> in their life cycle?**

- a) Tetra Pak.
- ☒ Returnable bottle glass.
- c) Bottle glass disposable.
- d) Plastic bottle.
- e) Can of metal.

**44. Which of these products has a higher water footprint?**

- ☒ Eggs.
- b) Snuff.
- c) Milk.
- d) Wine.
- e) Beer.



**45. On average, more energy is spent at home to...:**

- ☒ Temperature condition of rooms (heating in winter and air conditioned in summer).
- b) Lighting.
- c) In the kitchen (fire and oven).
- d) Operation of appliances (refrigerator, blender).
- e) Operation of electronic equipment (TV, computer).

**46. Which of these appliances use more energy put into the “stand by” mode?**

- a) Modem
- b) Computer
- ☒ Stereo
- d) Cell Charger
- e) Television

**47. Which means of transport spends less energy (per person per kilometer)?**

- a) Car.
- ☒ Buses
- c) Urban Collective.
- d) Train.
- e) Aircraft.

**48. How many times more water is needed to produce one kilogram of beef, compared to a kilogram of staple foods such as potatoes, corn or wheat?**

- a) 2 times.
- b) 3 times.
- c) 500 times.
- ☒ 15 times.
- e) 300 times.

**49. The production and transport of batteries need...**

- a) 5 times
- b) 1000 times
- c) 2000 times
- ☒ 50 times
- e) ... 10,000 times more energy than containing.

**50. After how many years is a plastic bag completely degraded in a landfill?**

- a) 1 year.
- b) 10 years.
- c) 50–100 years.
- d) 400–500 years.
- ☒ Never.

**51. Which recycled material saves more energy in comparison to producing it?**

- ☒ Aluminum.
- b) Glass.
- c) Can.
- d) Paper.
- e) Plastic.

**52. How many times can returnable beer containers be reused on average?**

- a) 5 times.
- b) 1000 times.
- c) 200 times.
- ☒ 40 times.
- e) 800 times.

**53. How much water is needed for a bath in the tub?**

- a) 20 liters.
- b) 50 liters.
- c) 1000 liters.
- ☒ 200 liters.
- e) 4000 liters.

**54. What is the average water daily consumption per person in Chile?**

- a) 10 liters.
- ☒ 170 liters.
- c) 500 liters.
- d) 1000 liters.
- e) 1500 liters.

**55. What is the average electricity monthly consumption in a Chilean family home (4 people)?**

- a) 2000 kWh.
- b) 15,000 kWh.
- c) 10 kWh.
- ☒ 220 kWh.
- e) 20 kWh.

**56. How long does it take to recover the cost of an efficient light bulb?**

- a) 2 years.
- b) 2 days.
- ☒ 4 months.
- d) 5 years.
- e) 1 week.

**57. When driving a car, which of these activities causes more fuel to be spent than necessary?**

- a) Accelerate slowly and not to the end.
- b) Driving speed between 60–80 km/h.
- c) Do not use the air conditioning in the car.
- d) Do not accelerate the car after stopping.
- Driving with open windows.

**Pro-Environmental Behavior (35 items)**

Likert	Never	Seldom	Occasionally	Usually	Always	N/A
I ride a bicycle or take public transportation to work or school.						
* I buy organic food.						
<i>I take tub baths.</i>						
<i>I buy beverages in cans.</i>						
I wait until I have a full load before doing my laundry						
<i>I drive my car in or into the city.</i>						
<i>I wash dirty clothes without prewashing.</i>						
<i>For longer trips (more than 500 km), I take an airplane.</i>						
<i>If I am offered a plastic bag in a store, I take it.</i>						
In nearby areas (around 30 km), I use public transportation or ride a bike.						
I collect and recycle used paper.						
I bring empty bottles to a recycling bin.						
I have pointed out unecological behavior to someone.						
I contribute financially to environmental organizations.						
I buy drinks or beer in returnable bottles						
* <i>I buy frozen or prepared foods ready to heat.</i>						
I buy products in refillable container.						
I boycott companies with an unecological background.						
I buy seasonal produce.						
<i>I use a clothes dryer.</i>						
I talk with friends about problems related to the environment.						
<i>I keep the engine running while waiting for a train crossing</i>						
<i>I kill insects with a chemical insecticide.</i>						

Yes/No	Yes	No	N/A
* I produce my own organic food (fruits, vegetables or honey, <i>etc.</i> ).			
I reuse my shopping bags.			
<i>In the winter, I keep the heat on so that I do not have to wear a sweater.</i>			
<i>I put dead batteries in the garbage.</i>			
* I make compost with my organic waste (food scraps, fruit and vegetable waste).			
I am a member of an environmental organization.			
I own energy efficient household devices.			
I have already looked into the pros and cons of having a private source of solar power.			
I use renewable energy sources.			
I refrain from owning a car.			
I share the car with one or more people.			
* When I take a shower, I close the water, then I use the soap, then I open it again to rinse myself, avoiding to leave the water running all the time.			

*Items in italics* indicate negatively formulated behaviors; they are recoded and should be read as “I refrain from...”; \* New items developed by a group of environmental scientists. All the other items are from the scale of Kaiser and Wilson [1].

## References

1. Kaiser, F.G.; Wilson, M.R. Goal-directed conservation behavior: The specific composition of a general performance. *Personal. Individ. Differ.* **2004**, *36*, 1531–1544.

© 2015 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).