NatureIntelligence

Conceptual model, measurement scale and critical success factors

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Co-funded by the
Erasmus+ Programme
of the European Union

This framework has been developed as part of the Erasmus+ Strategic Partnership "Nature Intelligence in Youth Work", which is funded under the Erasmus+ Programme, project number 2020-2-NL02-KA205-003082.

The project partners include: Anatta Foundation (Netherlands), IVN Environmental Education (Netherlands), Kamaleonte ASD (Italy), Zavod Ambitia (Slovenia) and Čia Čekija – Natural Spirit (Czech Republic)

Details of the full report, youth work curriculum and other documents are available from the project website: www.natureintelligence.eu

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Suggested full report citation: Van den Berg, A.E. & Albers T. (2022). *Nature Intelligence in Youth Work: Conceptual model, measurement scale and critical success factors*. Aalten: Anatta Foundation.

Table of Content

Table of Content 3
Introduction 5

Chapter 1
Theoretical perspectives 6
The concept of intelligence 7
Inherited capacity or acquired skill? 7
Cognition or emotion? 8
General capacity or multiple abilities? 9
Implications for the concept of Nature Intelligence 9
Concepts relevant to Nature Intelligence 10
The educational perspective: Naturalistic Intelligence (NI) and Existential Intelligence (Ex-I) 10
The ecological perspective: Ecological Intelligence (Eco-I) 11
The nature-based perspective: Intelligence in Nature 12
Implications for Nature Intelligence 12
The concept of Nature Intelligence 13
A preliminary conceptualization 15

Chapter 2
Conceptual model of Nature Intelligence 16
Background 17
Person descriptions 17
Question 17
Descriptions 18
Data analysis 18
Results 19
Cognition 19
Emotion 20
Spiritual 20
Action 21
Reflection 22
NQ as an emergent property 22

Chapter 3
Development of a scale to measure NQ **26**
Psychological measurement 27
Item generation 28
Psychometric analysis 29
Statistical analysis 30
Overall scores 30
Gender differences 32
Age differences 32
User evaluation 33
Final NQ-36 scale 33
Limitations 35

Chapter 4
Nature Intelligence in youth work **36**
Environmental education 37
Encouraging cognitive competencies 38
Encouraging emotional competencies 39
Encouraging spiritual competencies 40
Encouraging the use of nature for health 42
Restorative environments research 42
Therapeutic nature programmes 43
Encouraging the use of nature for pro-environmental behaviour 44
Encouraging the use of nature for socializing 45
Common themes 45

Conclusion 47
References 48

Appendix A:
Descriptions of persons with a high NQ **53**

Appendix B:
Outcomes of factor analyses and reliabilities **56**

Introduction

This report is part of a project aimed at developing Nature Intelligence (NQ) in young people funded by the EU Erasmus+ programme. It sets the background and theoretical basis for the realization of an innovative curriculum for promoting NQ as an integrative concept for youth work to empower young people to use nature for their well-being and to actively contribute to a greener and more sustainable Europe and planet. The project starts from the basic premise that one's own well-being is closely interwoven with the well-being of nature and the planet, and that understanding and feeling this connection can help make the world a better place for both humans and nature.

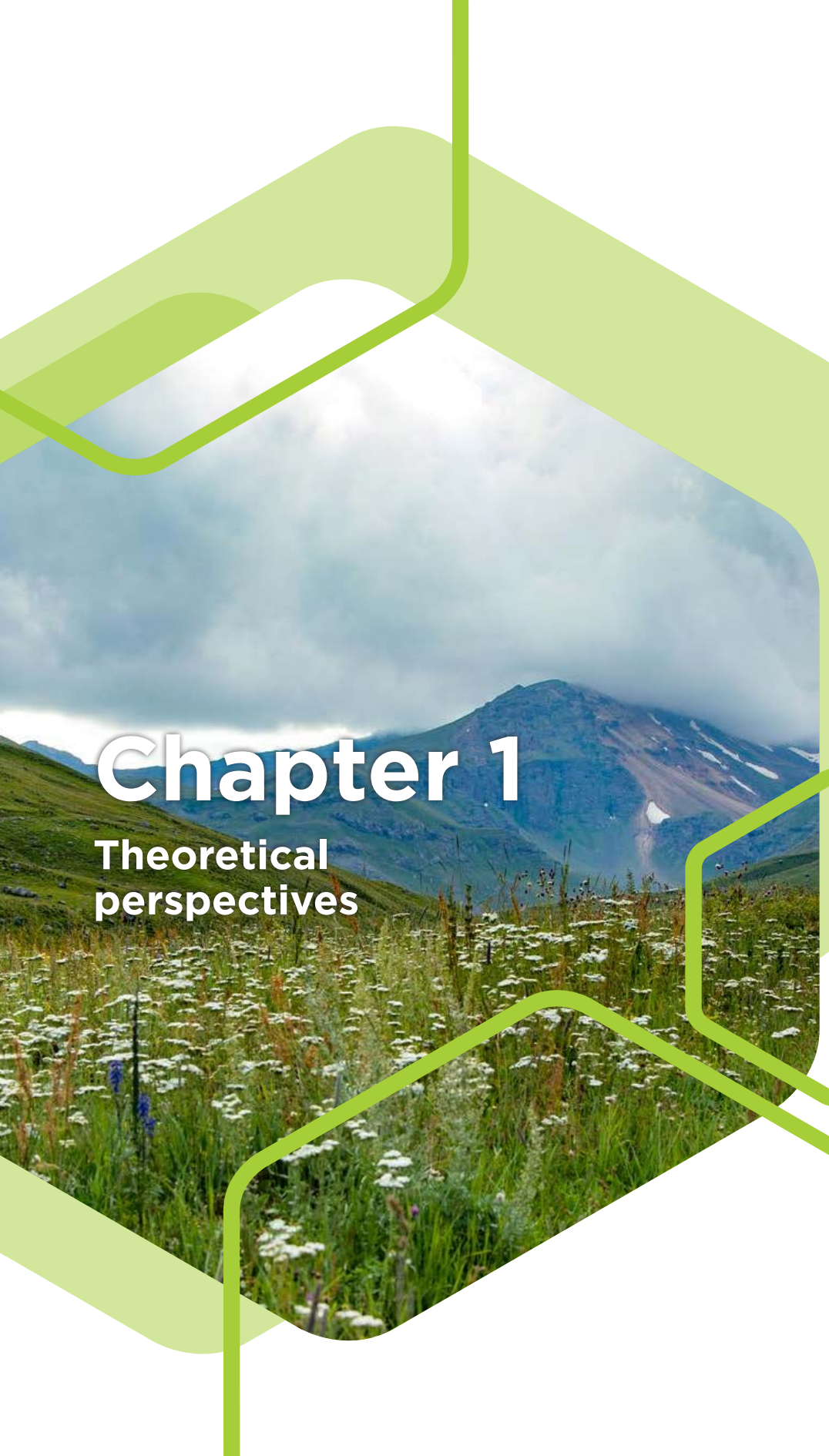
The project fits within the new EU Youth Strategy (2019-2027) of the European Commission that focuses on the connection, engagement, and empowerment of young people. The project addresses these three core areas as follows:

- **Connection:** the project aims at increasing nature connection, which will not only lead to a higher nature intelligence and a deeper appreciation of nature, but will also connect (young) people transculturally, as nature is a connecting element between societies.
- **Engagement:** a stronger connectedness to nature and a higher nature intelligence will lead to meaningful civic and environmental participation of young people. For example, cognitive, emotional and spiritual connections with nature lead to increased pro-environmental behaviour at local and national level.
- **Empowerment:** by promoting a set of competencies in young people that will stimulate their nature intelligence, the project will promote their health and well-being as well as their active environmental citizenship at local and (inter)national level.

The EU Youth Strategy aims to contribute to realising the vision of young people, expressed in 11 European Youth Goals[1]. This project directly contributes to Youth Goals 5 and 10, which respectively aim to address young people's mental health and wellbeing, and a sustainable green Europe. Through the development of young people's nature intelligence and nature connectedness, their competencies regarding their mental health and wellbeing are improved, as is their way of relating to the natural world around them.

The Nature Intelligence programme comprises three outputs: a theoretical and conceptual framework (O1), a manual for youth workers (O2) and a training course (O3). This report is part of O1 and aims to provide a common ground for developing the more applied activities in O2 and O3. Building on both theoretical and practical knowledge and insights, a conceptual model is developed that describes NQ as a multidimensional, integrative concept that comprises cognitive, emotional, spiritual and action-based competencies. The report also introduces a scale for measuring NQ, along with an overview of critical success factors for fostering NQ as they emerge from the relevant literature.

1 https://europa.eu/youth/strategy/european-youth-goals_en



Chapter 1

Theoretical perspectives

The first step in exploring the concept of Nature Intelligence (NQ) is to look at what has already been written about this topic. This chapter provides an introduction to the scientific literature on the concept of NQ. The aim is not to provide a complete review of this diverse and complex area, but rather to give a global overview in order to relate the new concept of NQ to previous theorizing and research.

The literature review starts with a short introduction to the general concept of intelligence followed by a classification of three theoretical perspectives on the concept of NQ: the educational perspective, the ecological perspective, and the nature-based perspective. It concludes with a description of four relevant domains of NQ as they emerge from the literature, along with a preliminary conceptualization of NQ.

The concept of intelligence

1.1

Differences between people, in their broad powers of intelligence, have been recognized since antiquity. Intelligence was long considered as a general, innate capacity, unmalleable by training or education. This general intelligence can be defined as "the capacity to acquire and apply knowledge." It includes the ability to benefit from past experiences, act purposefully, solve problems and adapt to new situations.

In the early 20th century, German psychologist William Stern coined the term 'Intelligence Quotient", or IQ, as a measure of a person's relative intelligence level compared to others. Since then, intelligence testing has become a widely used tool in many domains, including screening of employees and as a means of identifying students with special needs. However, the ongoing debate over the use of such testing continues: it has been argued that IQ tests are biased towards the white Western societies in which they were developed, and do not do justice to people from other cultural backgrounds.

IQ tests are biased towards the white Western societies in which they were developed.

Underlying the debate over IQ testing are differing views on what intelligence is and how it should be defined 01. These differing views revolve around three key issues:

1. Is intelligence an inherited capacity or an acquired skill?
2. Is intelligence a cognitive or emotional skill?
3. Is intelligence a single mental capacity or a set of multiple abilities in different domains?

Inherited capacity or acquired skill?

The idea of some people being born more intelligent than others is highly controversial 02. Particularly in the US, this idea has been used for dubious purposes such as claims for racial superiority and discrimination against those classed as 'feeble-minded'. As such, the genetic perspective on IQ has become intertwined with racism and xenophobia. From an educational perspective, viewing IQ as an inherited trait challenges the usefulness of special educational opportunities for the underprivileged, while people who believe that

environment and upbringing play a large role in intelligence tend to support such programmes.

Today, experts generally agree that heredity and environment have an interactive influence on intelligence. Many researchers believe that there is a reaction range to IQ, which refers to the limits placed on IQ by heredity. Heredity places an upper and lower limit on the IQ that can be attained by a given person. The environment determines where, within these limits, the person's IQ will lie. Despite this prevailing view that both heredity and environment influence intelligence, researchers still have different opinions regarding how much each one contributes and how they interact. For example, a recent survey among 102 experts showed that 40% favoured a more environmental perspective, 43% favoured a more genetic perspective, and 17% of the experts assumed an equal influence by genes and environment 02.

Cognition or emotion?

A major concern about IQ testing it that it has limited value in terms of predicting who will succeed in life.

A major concern about IQ testing it that it has limited value in terms of predicting who will succeed in life. This observation has inspired the concept of Emotional Intelligence (EQ) as an addition to IQ. The search for characteristics other than IQ to adequately explain variations in success is by no means new. For example, in 1920, Thorndike had already suggested the concept of 'social intelligence' as a means of explaining variations in outcome measures not accounted for by IQ. That said, the idea that there is an emotional dimension to intelligence only gained widespread interest with the publication, in 1996, of a popular-scientific book by Daniel Goleman entitled *Emotional intelligence*, why it can matter more than IQ.

EQ can be broadly defined as "an ability (or capacity) that helps people to perceive, express, understand, and regulate emotions". According to Goleman, EQ can be split up into four domains, that vary along dimensions of self/social and awareness/management: Self-Awareness (the ability to recognize one's own moods and drives and their effect on others), Self-Management (the ability to control or redirect disruptive impulses and moods), Social Awareness (the ability to understand the emotional make-up of other people), and Relationship Management (proficiency in managing relationships and building networks). Each domain comes with corresponding competencies. The concept of EQ has particularly gained ground in management practice, where it is considered more relevant than IQ for predicting people's performance 03.

No consensus as yet has been reached about EQ being a kind of intelligence. Some researchers believe that it is merely a collection of personality traits such as empathy and extraversion. Equally, there is currently no agreement on the relative importance of IQ and EQ with regards to success in life. It may even be questioned whether EQ can be distinguished from IQ. Findings from brain imaging research indicate that emotional and cognitive processes are typically present at the same time. Just like reason and cognition, emotions seem to emerge from higher order processing in newer layers of the brain 04. However,

most researchers agree that some form of emotional intelligence is a relevant factor for the understanding of why some people do better in life than others.

General capacity or multiple abilities?

While many scientists still believe in a general intelligence factor that underlies all intelligent behaviour, as proposed by Spearman, others are critical, because it is obvious that people can score highly on one specific ability but show weakness in other domains. Think, for example, of a *prodigy*, who excels in mathematics or music but underachieves in other domains. In 1985 Robert Sternberg 05 proposed his triarchic theory as an alternative to the idea of the general intelligence factor, as measured by intelligence tests. Sternberg argued that practical intelligence—a person's ability to react and adapt to the world around them—as well as creativity are equally important when measuring an individual's overall intelligence. He also argued that intelligence is not fixed, but rather comprises a set of abilities that can be developed.

Around the same time, Howard Gardner proposed his theory of multiple intelligences in a book entitled *Frames of mind, the theory of multiple intelligences* 06. According to the latest version of this theory, there is not one kind of intelligence but nine, which are relatively independent of one another. These nine types of intelligence are:

- Linguistic: spoken and written language skills
- Logical–mathematical: number skills
- Musical: performance or composition skills
- Spatial: ability to evaluate and analyse the visual world
- Bodily-kinaesthetic: dance or athletic abilities
- Interpersonal: skill in understanding and relating to others
- Intrapersonal: skill in understanding the self
- Existential: ability to ask (and answer) deep questions about human existence
- Nature: skill in understanding the natural world

According to Gardner, each of these intelligences, including the "naturalistic intelligence", has inherent value but culture and context may cause some domains to be emphasized over others. Critics of the idea of multiple intelligences maintain that these abilities are talents rather than kinds of intelligence. The Multiple Intelligences theory has also received much criticism for its lack of empirical evidence1. As an example, a study among school children found that children's multiple intelligence scores in the various domains did not predict their academic achievement scores in those domains 07.

Implications for the concept of Nature Intelligence

The current project focuses on Nature Intelligence (NQ) as a new concept that builds upon existing ideas on intelligence in general. An important lesson to be learnt is that there are fundamental differences in views on how intelligence is to be defined, and that these different views need to be considered when defining NQ.

The current project focuses on Nature Intelligence (NQ) as a new concept that builds upon existing ideas on intelligence in general.

For preliminary purposes, regarding the concept of NQ, it will be assumed that:

1. NQ is a capacity that is both an inherited aptitude and an acquired skill. It can, as such, be effectively influenced by educational or other programmes, taking into account a person's pre-determined bandwidth.
2. NQ combines both cognitive and emotional capacities and skills. The cognitive capacities relate to recognizing patterns in nature and identifying different plants and species. The emotional abilities involve empathizing with nature and using that empathy to manage one's own health and well-being, as well as the well-being of the planet
3. NQ fits within a broader view of intelligence as a set of multiple of abilities. Within this broader view, NQ can in itself be seen as a multidimensional concept that combines nature-based skills in cognitive, emotional and action domains.

1.2 Concepts relevant to Nature Intelligence

In this section, three relevant perspectives to the concept of NQ are discussed. Firstly, naturalistic intelligence is discussed as one of the nine intelligences proposed by Gardner. This concept is mostly applied in the educational practice, and it is closely related to the concept of NQ. Subsequently, the concepts of ecological intelligence and nature's intelligence are discussed.

The educational perspective: Naturalistic Intelligence (NI) and Existential Intelligence (Ex-I)

Naturalistic Intelligence and Existential Intelligence are two types of intelligences identified by Gardner in his theory of multiple intelligences. This theory is widely used in educational practice to identify the specific talents and abilities of students. Gardner's Naturalistic and Existential intelligences were not present in the original version of the theory, published in 1983, and were subsequently added as additional intelligences in a book chapter, published in 1999 [08]. These two intelligences can be described as follows:

Naturalist Intelligence involves how sensitive an individual is to nature and the world. People who excel in this intelligence are typically interested in growing plants, taking care of animals or studying animals or plants. Zookeepers, biologists, gardeners, and veterinarians are among those that Gardner sees as having high naturalist intelligence.

Some of the characteristics of students with Naturalistic Intelligence include:

- Intense interest in learning about nature
- Vivid enthusiasm when in contact with nature
- Dislike for pollution
- Powers of observation in nature
- Awareness of changes in weather
- Expertise at categorizing information and recognizing patterns

In the field of education, many suggestions can be found regarding how to foster children's or students' Naturalistic Intelligence, such as: getting students in direct contact with nature (through nature walks, camping, visits to zoos and aquariums), stimulating them to closely observe nature (by giving them a magnifying glass, a microscope or binoculars), encouraging students to classify what they find in nature (by keeping a field diary with annotations and photos) and inspiring them to have nature related hobbies, such as planting seeds at home or collecting fossils, stones, leaves, etc.

While the concept of Naturalistic Intelligence is closely related to NQ, it hinges strongly on lower order cognitive capacities of studying, observing and learning about nature. Higher-order cognitive skills, such as understanding natural phenomena and connecting pieces of information to get deeper or new insights are not included. A positive attitude and emotional affinity towards nature is part of the concept, but it is not a dominant dimension.

Existential Intelligence involves the ability to use intuition, thought and meta-cognition to ask (and answer) deep questions about human existence. People who are inherently existential are authentic individuals, who are true to themselves and ask questions such as: Who are we? Why are we alive? Do we have a purpose? Why and how are we conscious? What is the meaning of life? According to Gardner, recognizing and understanding our interconnectedness with the world around us and the universe is an element of Existential Intelligence. Gardner argues that a key attribute of Existential Intelligence is being able to perceive the bigger picture or, in other words, to conceive our lives and every-day actions in the context of the grand cosmic arena.

While Existential Intelligence is broader than NQ, it captures the spiritual dimension of NQ as a feeling of being connected to the larger scheme of the natural world.

The ecological perspective: Ecological Intelligence (Eco-I)

Building on his earlier book on emotional intelligence, psychologist and science journalist Daniel Goleman proposed the concept of Ecological Intelligence in another popular-scientific book entitled *Ecological Intelligence: How knowing the hidden impacts of what we buy can change everything*. In this book, published in 2009, Goleman starts from his own ideas on Emotional Intelligence to "enrich" Gardner's concept of Naturalistic Intelligence. Just as Emotional Intelligence builds on the ability to take another's perspective, empathize, and show concern, Ecological Intelligence extends this capacity to all natural systems. According to Goleman, we display empathy when we feel distress at the "pain" endured by the planet or resolve to make things better.

Thus far, Ecological Intelligence is mostly a theoretical idea. Some preliminary attempts have been made to develop measurement scales [09], but Ecological Intelligence remains a somewhat vague and ambiguous concept imbued with ideologies. Nevertheless, the observation that empathizing with all natural

systems is key in motivating people into action to preserve the planet, or their own well-being, seems to resonate with educational practice and increasingly receives support from empirical studies [10].

The nature-based perspective: Intelligence in Nature

Dating back to the earliest Greek philosophers, people have viewed the natural world as intelligent – being alive and ensouled. Throughout nature there is evidence of order and form in living structures, and those structures seem to be closely aligned with human functioning. Nature's intelligence is, among other things, reflected in the regenerative powers of living organisms. If you cut your hand, it will heal itself. If you sever the head of a flatworm, a new one will grow in its place.

Intelligence in nature is also visible in the proportional forms - self-similar and fractal - that can be found throughout nature. These proportional forms allow the parts to be integrated within the whole, giving rise to beauty and fascination. This natural beauty is reflected in the form of flowers, spiral galaxies, nautilus shells - nearly every organic form found in nature.

In his 2005 book entitled *Intelligence in nature: An inquiry into knowledge*, anthropologist Jeremy Narby describes and translates shamanic cultures and traditions into scientific insights on nature's intelligent functioning [11]. He presents anecdotal evidence that intelligence is not unique to humanity alone: bacteria, plants, animals, and other forms of nonhuman life also display a capacity for self-deterministic decisions, patterns and actions. In his book, Narby not only uncovers intelligent behaviour within the natural world, but equally explores the question of what humanity itself can learn from nature's economy and knowingness in our own search for a healthier and more sustainable way of life.

If you sever the head of a flatworm, a new one will grow in its place.

The idea that nature is intelligent is most firmly established and applied in the field of Artificial Intelligence (AI). AI strives to imitate nature; the main pursuit of this field is replicating in a computer the exact processes that can be found in nature. In the context of AI, intelligence of nature is sometimes referred to as "nature intelligence" [12]. This might create confusion and indicates that it is important to distinguish the concept of Nature Intelligence (NQ), as a characteristic of humans, from the concept of "nature intelligence" as a characteristic of nature itself.

Implications for Nature Intelligence

NQ being a new concept, it is important to identify the differences and similarities with related concepts, as discussed above. These differences and similarities can be described as follows:

1. NQ is closely related to the concepts of Naturalistic Intelligence (NI) and Existential Intelligence (Ex-I). NQ encompasses all the characteristics of NI. However, compared to NI, there is a stronger emphasis on an

emotional/affective relationship with nature than on cognitive aspects (such as nature study). NQ also extends NI with an action dimension that includes the ability to use nature for self-regulation and well-being, and for making the planet greener and more sustainable. NQ is an element of Ex-I. It captures the importance of an interconnectedness to nature for spiritual well-being. In general, NQ could be a mix of both NI and Ex-I.

2. NQ partly overlaps with the concepts of Ecological Intelligence (Eco-I). Most importantly, it shares with Eco-I the emphasis on an emotional connection to nature and the importance of this connection for an awareness and readiness to protect the Earth's limited resources. A major difference is that Eco-I does not pay much attention to the usefulness of nature as a self-regulating support to promote personal health and well-being.
3. NQ is only indirectly related to the concept of intelligence in nature. There is some communality in the idea that nature possesses an intelligence of its own and that humans, as part of nature, can also use this intelligence to improve their own well-being and that of the planet. Moreover, the awareness of the natural world as being alive and ensouled can lead to a spiritual experience of feeling humble in the grander scheme of the cosmos. However, it is clear that the intrinsic intelligence of nature is very different from the intelligence of humans in recognizing and using the intelligence of nature for their own purposes. Regarding the distinction between the two concepts, it would seem helpful to consistently use the abbreviation NQ for Nature Intelligence as an indication that it is, just like IQ and EQ, a capacity of humans, not of nature itself.

More specifically, NQ comprises four dimensions: cognition, emotion, spiritual and action.

The concept of Nature Intelligence

1.3

As described in the previous sections, NQ is an integrated multidimensional concept that combines elements of various types of nature-related intelligences as previously described in the literature. More specifically, NQ comprises four dimensions: cognition, emotion, spiritual and action. These four dimensions can be described as follows:

The cognition dimension of NQ taps into the 'classic' skills that are the focus of environmental education: environmental knowledge, attitudes and behaviours. In relation to NQ, higher order cognitive skills seem particularly relevant. These skills, which are also described as critical thinking skills or 'meta-cognition', involve an ability to analyse, interpret and connect concrete pieces of knowledge about nature to gain deeper insights. Using higher order cognitive strategies makes people more aware of their own thinking, and more likely to be motivated learners who can put their thoughts into action. However, as described by Bloom's taxonomy of learning skills [13], lower-order skills, such as recognizing plants and animals, understanding their function, and applying this knowledge in practice must be mastered first for higher-order skills to be developed.

The emotion dimension of NQ evolves around the feelings of connectedness to nature as a key determinant of NQ. Connectedness to nature (also referred to as *relatedness to nature*) has been defined as a perceived relationship of interconnection between the self and the natural world. It reflects a sensation of kinship and an affective individual experience of connection with nature, both psychologically and physically, through direct embodied experience [14]; [15]. Various measures of connectedness to nature are available, and empirical findings using these measures have shown consistent relationships with outcome variables related to action dimensions of health and well-being [16], as well as altruism and sustainable behaviour [17]. Theoretically, the positive impacts of connectedness to nature can be understood by the biophilia hypothesis as proposed by Edward Wilson [18]; [19]. According to this hypothesis, humans are genetically predisposed to being attracted to nature because we are ourselves part of nature, and the human species has evolved in close interaction with nature. We inherently love the natural world and connecting to nature strengthens that bond and brings positive outcomes in many domains of human functioning, including health and well-being as well as sustainable behaviours.

The spiritual dimension of NQ refers to a feeling of transcendence and interconnectedness, based on the realization that the natural world that surrounds us is alive and intelligent, just as humans are. This dimension is most clearly described by the concept of Existential Intelligence but is also captured by Ecological Intelligence. It combines feelings of nature connectedness with the meta-cognition of nature being larger than ourselves. The spiritual dimension of NQ may come into focus, particularly when people are in touch with their authentic self. Consequently, authenticity, in the sense of being true to oneself and one's principles, seems to be a precondition for spirituality. At the same time, authenticity can also be a result of NQ, when people discover their true self through contact with nature.

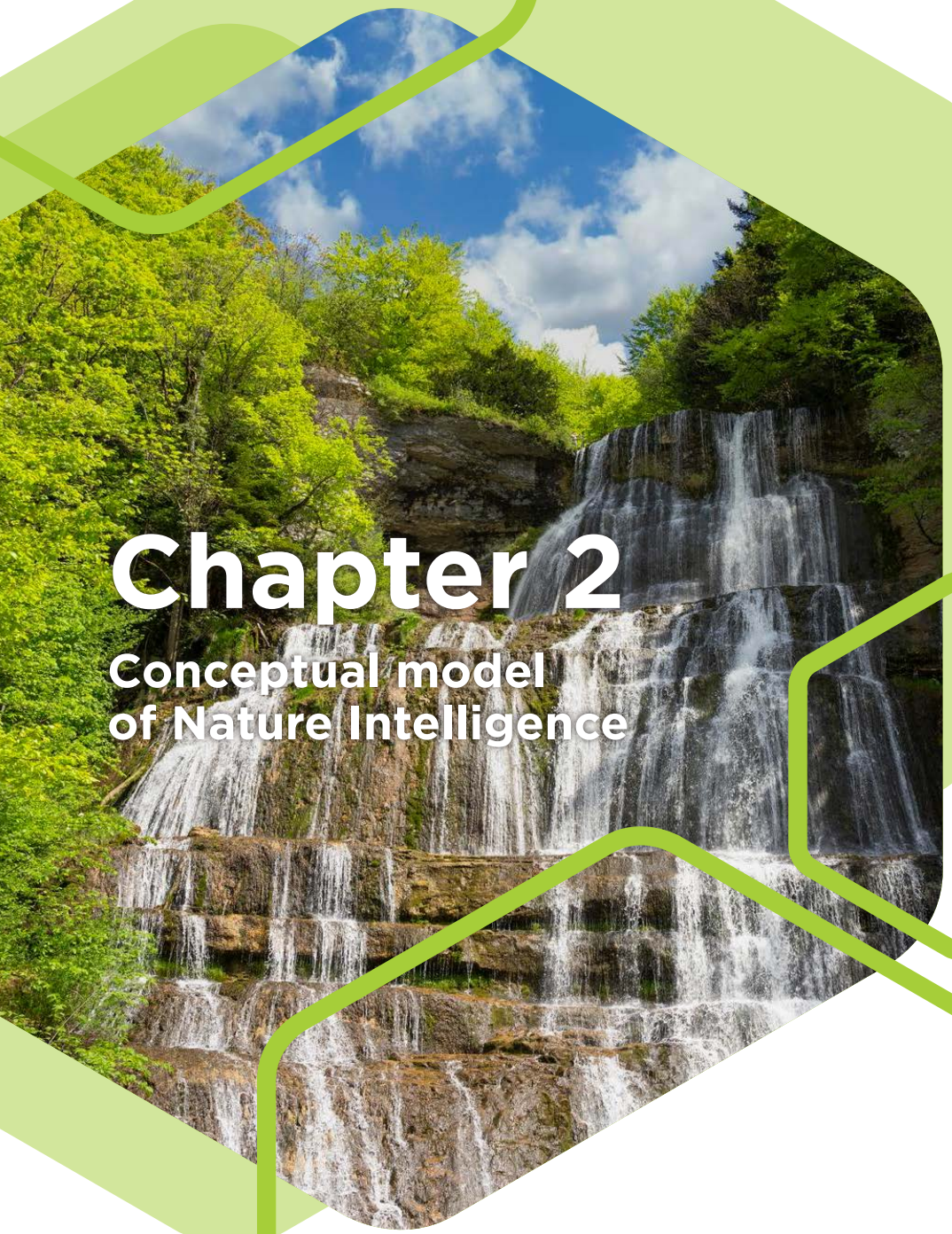
We inherently love the natural world and connecting to nature strengthens that bond and brings positive outcomes in many domains of human functioning, including health and well-being as well as sustainable behaviours.

The action dimension of NQ comprises of two broad types of behaviours: (1) the use of nature for self-regulation and well-being, and (2) engaging in activities to make the planet greener and more sustainable. As discussed above, both behaviours are supported and promoted when a person becomes more aware of the importance of nature, and more connected to nature. This dimension is, thus, more or less the 'automatic' result when the cognition, emotion and spiritual dimensions of NQ are realized. However, in order for youth to actually engage in these behaviours, it is essential to overcome obstacles for taking action as well as recognising and grasping possibilities for action [20]. Moreover, new habits and routines may be necessary for a durable implementation of the action dimensions.

A preliminary conceptualization

NQ can be preliminary conceptualized as:

"The capability of individuals to identify themselves as part of the natural world, to experience a sense of care and respect for nature, to have concrete and abstract knowledge about the natural world, and to actively use these competencies to engage in activities that promote lasting changes in individual wellbeing and the way societies relate to the planet and its ecosystems"



Chapter 2

Conceptual model of Nature Intelligence

Background 2.1

In this section, a conceptual model of Nature Intelligence (NQ) is presented based on the theoretical insights discussed in Chapter 1 in combination with hands-on-experience from youth organizations. Partner organizations of this project were asked to give a description of a young person with a high NQ, based on their experiences with youth work. These descriptions were used to (1) check whether the competencies of NQ as they emerge from the literature are recognized by the youth organizations who work with NQ in practice and (2) to identify dimensions and/or competencies that are not yet identified and might be added.

In what follows, it is first described how the person descriptions were collected and analysed. Then, each of the four dimensions of NQ (Cognition, Emotion, Spiritual, Action) are discussed in relation to the person descriptions. In doing so, person characterizations that fit within competencies that emerged from the theoretical analysis are identified, as well as characterizations that suggest additional competencies. The chapter concludes with a reflection on the nature of NQ and a conceptual model of NQ.

Person descriptions 2.2

The four youth organizations that are partners in this project were asked to submit a (written) description of a person with a high nature intelligence (NQ). The organizations could write their answer in a word document, that started with an explanation of the purpose of the exercise as "providing deepening experiential information from the field of youth work that is complementary to the theoretical framework". The persons' descriptions can be found in Appendix A.

Question

Youth organizations were asked to give a description of an example of a young person with a high nature intelligence. This could be a real person that joined a programme, or a fictional person composed of multiple persons that have joined a programme. Organizations were encouraged to describe the person in terms of both "trait and state" – i.e., more structural innate (trait) characteristics, and more fluent (state) capacities that signal a potential and capacity to acquire nature intelligence.

In order to aid the organizations formulate their answer, the following guiding/example questions were added:

- What makes you think this person has a high nature intelligence?
- What do you think made this person have a high NQ (nature/nurture)?
- Which specific competencies does this person have that are related to NQ?
- What kind of opinions/attitudes does this person have that are unique to her/his NQ?
- What kind of emotions or feelings are related to this person's NQ?

- What kind of behaviour does this person show that you think is unique to her/his NQ?
- How do you think this person's well-being is related to the levels of NQ?
- How may youth work influence this young person's development of nature intelligence (or nature connection)?
- What do you admire about this person's NQ?

Partner organizations were asked to send in one person description per organization, with a suggested length of 100-200 words (but it was emphasized that there was no strict word limit, and that longer descriptions were also welcome). They were encouraged to write their answers in an easy-to-understand-language that youth workers can relate to.

Descriptions

Cia Cekija (CC) described the imaginary experiences of a person named Renata, while she was on a week-long pilgrimage through different types of natural landscapes. These experiences include many momentary actions and experiences, such as gathering some herbs for the evening tea and collecting rubbish along the path.

IVN described a person named Laura, capturing traits of various people the organization has worked with in the past and present. According to the description, Laura is an authentic person who is very open to new people and experiences.

Kamaleonte (KAM) described a person called Cristiano, who lives near the sea, and who has a passion for fishing. The description includes observations of his character as well as his experiences and the benefits he gets from those experiences.

Ambitia (AMB) described a fictional person, similar to the TV series *Grizzly Adams* character who lives with his bear up in the mountains where he managed to blend in with the environment and become one with nature.

Data analysis

Person descriptions were analysed by the academic partner using a qualitative approach that started with subdividing each person description into different statements or fragments. An example of such a statement could be: "she feels at home in the forest". Subsequently, each of the statements was assigned to one of the broad dimensions of Emotion, Cognition, Spiritual, and Action. To each of these dimensions, a specific competency was subsequently assigned. For example, "she feels at home in the forest" was assigned to the competency **Connectedness** within the **Emotion** dimension.

Preliminary results of the analysis were discussed during an online meeting with the partner organizations to ensure the accuracy of the assignment of the classification and to identify any missing competencies in the concept of NQ.

Results

2.3

This next section describes the competencies of the four dimensions of NQ (Cognition, Emotion, Spiritual, Action) as they emerged from the person descriptions, along with some characteristics' examples.

Cognition

There were relatively few references to cognitive competencies in the descriptions of a person with a high NQ: only about one fifth of the statements fall into this category. This might, however, be due to the specific background of the partners. Organizations working from a more education/nature study perspective might find this category more important. Three distinctive types of emotion-related competencies can be distinguished:

Literacy. Youth organizations did not make a clear distinction between lower and higher order cognitive competencies. Instead, they described persons with a high NQ as having a "nature literacy" - an intuitive understanding of the dimensions, elements, patterns and processes of nature. In discussing this competency, the term *wisdom* was also mentioned. Some examples:

- ability to notice the different possible perspectives and interconnections of her surroundings (IVN)
- Following an old path, she feels that this is the right direction (CZ)

Curiosity. In addition to an intuitive understanding of nature, several descriptions of a person with a high NQ also included references to a more deliberate awareness of the intrinsic value of nature. When discussing this competency, it was suggested that it could be a combination of interest in and respect for nature (not wanting to harm it and wishing to preserve its beauty and functions) as well as the awareness that this sense of respect is essential for the existence of humanity. Some examples:

- picks up mushrooms and soil with a respectful yet very natural attitude (KAM)
- he makes sure to cut the mushroom instead of tearing it from the soil, so it can grow again in years to come (KAM)
- There was no judgement of nature and its elements (AMB)
- And he reflected humility, admiration and respect (AMB)

Outdoor skills: A category of practical knowledge and basic skills for staying outdoors and living in nature clearly emerged from the descriptions, and even seemed the most important one within the cognitive dimension of NQ. Some examples:

- She gathers some herbs for the evening tea (CZ)
- In the camp, she will build her shelter, help with starting a fire and cook dinner (CZ)
- He likes the fact that fishing is a challenging activity that requires him to think about new strategies, to understand the fish's behaviour (KAM)
- picks up a mushroom or another plant (that he eats with pleasure)(KAM)
- He lived a the house he built from materials the forest offered (AMB)

Emotion

The descriptions of a person with a high NQ contained many references to emotion related competencies: about half of all statements fall into this category. Three distinctive types of emotion-related competencies can be distinguished:

Connectedness: This type of competency, as described in the theoretical framework, is clearly reflected in all the descriptions. It comprises the ability to connect to nature, to care for other living beings, to live in harmony and balance with nature, and to identify oneself as part of nature. Some examples:

- She feels at home in the forest (CZ)
- Strives to live in balance with her natural surroundings (IVN)
- To him, fishing means [...] being in harmony with the natural environment (KAM)
- He managed to blend in with his environment and became one with nature (AMB)
- cares deeply for all living beings (IVN)

Embodiment: In addition to a more psychological connectedness, a direct connection with nature through physical contact, or an embodied experience, emerged from the descriptions. This type of competency also seems to imply resilience against more adverse conditions in nature, such as bad weather or dirt. Some examples:

- He also understood and surrendered to the cycles of life and embraced the different weather of every season of the year (AMB)
- He spends most of his free time in the sea, fishing no matter the weather conditions or the season (KAM)
- In rain or heat, high waves or calm sea, for him the sea is always attractive (KAM).

Open-mindedness: It was also mentioned that a person with a high NQ has an open mind, enjoys all aspects of nature, even the things that others might find scary or disgusting. This indeed seems to be an important quality that did not emerge so clearly from the literature review. Some examples:

- He learnt [...] how to be independent, how to face unpredictable events such as the risk of drowning and how to deal with the uncertainty of being caught in rough waters (KAM)
- Nature was his home, and he did not fear it (AMB)
- He likes all aspects of it, including the slimy consistency of the worm he uses for fishing (KAM)

Spiritual

There are a few direct references to spirituality in the descriptions of a person with a high NQ. This competency seems to be partly covered by the emotion dimension, especially when it comes to sensing a connection to nature as being greater than oneself, the feeling of 'dissolving in nature'. However, when

discussing this dimension, all partners felt it is of vital importance to NQ, even though it is difficult to put into words. This dimension can be composed of three types of competencies:

Transcendence: During transcendent experiences (also referred to as 'magical moments' or 'peak experiences') people feel lifted beyond the hustle and bustle of daily life, their sense of self fades away, and they feel connected to something bigger. In such states, people typically report feelings of awe and rapture; of time stopping; and of feeling a sense of unity with other people, nature, God, or the universe. Example:

- collecting firewood is a cosmic experience for her (CZ)

Mindfulness: There were quite a few references to a person with a high NQ taking in nature with all senses, having a mindful sensory experience of nature. This also seems to be an important type of competencies that was not yet identified in the literature review. Some examples:

- Listening to birds and trees, sensing the river down in the valley, touching stones along the way and breathing in air full of flowery scents makes her almost dissolve into her surroundings (CZ)
- walking with an intention through landscape and time (CZ)
- the perceptiveness he has towards all the natural phenomena and objects that he encounters on the beach (KAM)
- feeling his strength instead of simply thinking about his strengths (KAM).

Authenticity: Spirituality also involves the capacity to be true to oneself, to be an authentic person guided by one's own inner principles. Examples:

- a very authentic person (IVN)

Action

The action dimension of NQ refers to the ability to use emotional, cognitive and spiritual competencies for regulation of one's own health and the planet's health. Based on the person descriptions, it seems to be of intermediate importance: about a third of the statements fall into this category. Three types of action-related competencies can be distinguished:

Health: Most of the competencies in this category can be placed in the subcategory of 'using nature for self-regulation and health'. This confirms the relevance of this type of competencies for NQ. It is not so clear, however, whether these competencies are about deliberately going out into nature for health purposes, or about simply reaping the benefits of nature. For the purpose of this project, we will include both deliberate and non-deliberate use of nature for self-regulation. Some examples:

- She feels re-energized and calm after being in nature (IVN)
- [time in nature will result in] developing into a balanced adult (IVN)
- the sea makes him feel good and content about what he does (KAM)
- feeling regenerated after having walked through the forest or by the shore (KAM)

- likes to be challenged by nature and feels he learns a lot about himself and about how to regulate his emotions by experiencing a life in close contact with nature (KAM)
- The nature is there for him to reflect on his life (AMB)

Engagement: The idea that a person with a high NQ is motivated and capable of engaging in actions that make the planet greener and more sustainable is also supported by the person descriptions. Some examples:

- collects rubbish along the path (CZ)
- he brings with him a bag full of plastic and general waste he collected from the shore, as he wants the beach to remain clean. Moreover, all the waste that is recyclable, he either reuses himself or takes it to the recycling bin. (KAM)
- This person also learnt to track their carbon footprint, as the lives we live nowadays take a toll on nature (AMB)

Socialization: In the descriptions there were several mentions of young persons with a high NQ liking to spend time with friends in nature and using a shared interest for nature to strengthen connections with peers. Such a social implication of NQ seems highly relevant for the target group of youth and will therefore be included in the model. Some examples:

- together with friends who met at a spot near the pond (CZ)
- social time in nature will result in Laura feeling more at home within herself, society and the world (IVN)
- What youth work can do for young people is to offer them the opportunity to have outdoor experiences together with peers, reflect upon those collectively and share their insights. Such experiences could enable young people to become positive influencing role models for peers (KAM)
- intuitive (IVN)

2.4 Reflection

In general, the four dimensions of NQ – Emotion, Cognition, Spiritual, and Action– seem to be distinctive and comprehensive. Nearly all the competencies of persons with a high NQ as described by the youth organizations can be assigned to one of the four dimensions in a straightforward manner.

NQ as an emergent property

Given its multidimensional nature, the crucial question is how NQ arises from the four dimensions. In other words, how does a person transition from merely having skills in the individual domains to becoming nature intelligent? The view that will be advanced here is that NQ arises when a person has acquired skills or competencies in all four domains. From this perspective, NQ can be considered an *emergent property*. In general, an emergent property can be defined as "a property of a system that is not possessed by any of the individual parts of the system and that arises through the interaction between the parts" [21]. The most common examples used to illustrate how complex systems can give rise to emergent properties are water and consciousness.

Water for example, possesses properties that are quite different from its dimensions, oxygen and hydrogen. In a similar vein, the neurochemical interactions between brain cells cannot explain consciousness which is an emergent property of the complex system.

One of the partners in this project suggested that nature intelligence can be compared to a rainbow that starts shining unexpectedly under specific conditions, if one is in the right time and place: "It appears once a person is ready, shines out and does not leave anymore. The alchemy of melting together the knowledge of nature, the love for it, the feeling of interconnectedness and the inevitable need to act accordingly, brings a new special essence and understanding to a person's life. It is a flavour added to every thought, emotion, decision and action. There is a touch of miracle when seeing a rainbow, yet it is very natural. In a similar vein, there is a feeling that things are right when nature intelligence appears. It connects us to our roots and to the universe, it shows the way and gives meaning to our actions".

Definition and conceptual NQ model can be defined as:

"A multidimensional set of human qualities to connect to nature in a cognitive, emotional and spiritual manner, and to actively use these qualities to support both one's personal well-being as well as the well-being of nature and the planet"

Figure 2.1 below presents a graphical illustration of a conceptual model of NQ. The model takes the form of a flower with four leaves, representing the cognition, emotion, spiritual and action dimensions of NQ. The heart of the flower, where the four leaves overlap, is where NQ arises as an emergent property.

Figure 2.1.
The flower model

The four dimensions and competencies of NQ can be summarized as follows:

Cognition

- Literacy: knowledge about nature and natural processes
- Curiosity: a positive ecocentric attitude towards nature, respect for nature
- Outdoor skills: practical knowledge and skills for staying outdoors

Emotion

- Connectedness: the ability to connect to and care for nature, and to identify oneself as part of nature
- Embodiment: the appreciation of direct sensory contact with nature, even under adverse conditions
- Open-mindedness: having an open mind, appreciating all aspects of nature, even things that others might find scary or disgusting.

Spiritual

- Transcendence: realization that the natural world that surrounds us is alive, ensouled and interconnected
- Mindfulness: taking in nature with all senses, having a mindful sensory experience of nature
- Authenticity: the capacity to be true to oneself, to be an authentic person guided by one's by own inner principles

Action

- Health: using nature to self-regulate one's health and well-being
- Engagement: taking action to make the planet greener and more sustainable
- Socialization: enjoying spending time with friends in nature and use a shared interest in nature to strengthen connections with peers

Chapter 3

Development of a scale to measure NQ

Think of two young people, identical twins, and thus in many respects comparable: same age, same gender, same genetic make-up. Unfortunately, the twins were separated at birth, with one growing up in nature, among people who are concerned about nature and the environment, with lots of opportunities for being in touch with nature. The other twin grew up in a city, among people with little interest for nature, and with barely any access to nature. In their late teens, the twins are finally re-united. As it can be expected, it is a joyful reunion, both of them noticing a lot of similarities. There is, however, a major difference between the two: one is highly nature intelligent, and the other is not. For the twins, as well as their family and friends, this is an "experiential fact" that needs no further proof. But imagine that the twins were part of a research programme aimed at establishing differences in nature intelligence. How can such a difference be demonstrated? In other words, how can NQ be measured?

This chapter starts with a short introduction to psychological measurement. This is followed by the description of the development of a scale to measure NQ in three steps: item generation, psychometric evaluation, and a user session to check the appropriateness of the items for the target group of young people. Based on the outcomes of the scale development procedure a final 36-item version of the NQ scale is presented. The chapter concludes with a summary and discussion on how to use and interpret the outcomes of the scale and recommendations for further validation and development.

Psychological measurement

3.1

The first association that comes to most people's mind when thinking about measuring intelligence is "IQ test", with IQ test being the set of performance tests of verbal and non-verbal skills that results in general IQ score (e.g., the Stanford-Binet Intelligence Scale and the Wechsler scales). Historically, IQ was a score obtained by dividing a person's mental age score by that person's chronological age when administering an intelligence test. The resulting fraction (quotient) was multiplied by 100 to obtain the IQ score. In modern IQ tests, the raw score is transformed to a normal distribution with mean 100 and standard deviation 15.

Nature Intelligence – despite its abbreviation NQ – is very different from IQ. It is a multidimensional psychological concept, encompassing a broad array of nature-based capacities and skills in cognitive, emotional, spiritual and action domains. Such multidimensional psychological concepts are commonly measured with rating scales: a type of survey or questionnaire that uses closed-ended questions or statements about the skills in each domain that may apply more or less to a person [22]; [23]. Responses can be obtained through self-report, or by an expert or other 'informant' who knows the person in question well. Compared to informant ratings, self-report data is easier to apply but is also more prone to biases such as social desirability (giving answers that are socially acceptable rather than being truthful) and introspective inaccuracy (not being able to assess oneself accurately). However, meta-analyses have generally revealed high convergence between self and informant ratings of personality characteristics, and self-report remains the most widely used method of data collection [24].

Rating scales can be used to measure NQ as a trait (i.e., a structural personality characteristic) or as a state (i.e., a temporary state or experience). The main difference between the two formats is that trait measures use instructions to rate the extent to which the items apply to a person *in general*, while state measures use instructions to rate the extent to which the items apply to a person *in the current moment*, or *in the current situation*. In general, rating scales can be applied flexibly to obtain self and informant reports of trait and state personality characteristics.

The main challenge in scale development is selecting a set of items that, together, form a reliable and valid measure of the psychological construct of interest and its underlying dimensions. The steps in this selection process will be described in more detail in the next sections.

3.2 Item generation

As a first step, an initial pool of 53 items was created by searching the literature for pre-existing scales that are relevant for each of the four domains of NQ. These scales included both nature-based measures (i.e., naturalistic intelligence, nature connectedness), and more general measures (e.g., spirituality, self-regulation). In the latter case, items were rephrased in terms of nature-based skills. Additional items for each competency were formulated based on theoretical insights.

Table 3.1.
Overview of scales used to generate items for the initial item pool of the NQ scale, with sample items.

Dimension	Scales	Competency	Sample items
Cognition	NI[25]; MPQIII[26]; MIPC[27]; WSSES[28]; GSS[29]	Literacy	I am able to identify or classify living and non-living things that exist in nature
		Curiosity	I am interested in lessons or television shows, videos, books or objects about nature
		Skills	I possess skills to survive a few days in a nature area on my own
Emotion	NI[25]; MIPC[27]; CNS[14]; MSCS[30]; D-scale[31]	Connectedness	I think of the natural world as a community to which I belong
		Embodiment	I enjoy digging the earth with my bare hands
		Open-minded	Dead birds or other small animals in nature attract my attention without making me feel scared.
Spirituality	MPQIII[26]; CNS[14]; CAMS-R[32]; SMS[33]	Transcendence	I feel that all inhabitants of earth, human, and nonhuman, share a common 'life force'
		Mindfulness	Being in nature helps me to focus on the present
		Authenticity	Nature inspires me to live true to myself and my values and beliefs
Action	MPQIII[26]; AS[34]; NEP[35]	Health	After a visit to nature I feel refreshed and energized
		Engagement	I pay attention to my consumption habits out of respect for nature and the environment
		Socializing	It is important to me to share nature experiences with others

The initial pool of items was evaluated by the partner organizations during a workshop in Italy. Tables with the items were printed out on separate pages for each dimension. Subgroups of members of the organizations discussed the items and indicated for each item whether it should be kept, removed or adjusted. They also gave suggestions for revision of the items, and for new items to be included.

A key concern that emerged from the evaluations was the difficulty of distinguishing between general competencies (e.g., being a mindful, fearless or social person) and more specific nature-based competencies. In response to these comments, special attention was given to formulating the items in a nature-specific way. Based on the evaluations, a revised long-list of 60 items (5 per competency) was obtained.

Psychometric analysis

3.3

The 60-item NQ questionnaire was tested for its internal consistency and sensitivity to demographic characteristics among a convenience sample of 90 respondents in an online survey using Google Forms. The questionnaire, entitled 'Nature and Me', was introduced as a "questionnaire about your relationship with nature, consisting of 60 statements about your thoughts, feelings and actions that can apply more or less to your personal situation". The questionnaire was divided into four parts, corresponding to the four dimensions of NQ (Cognition, Emotion, Spiritual, Action). For easy understanding the parts were described as follows:

Part 1 is about your interest and knowledge of nature
Part 2 is about your feelings for nature
Part 3 is about the deeper meaning of nature
Part 4 is about the value of nature in your daily life

Respondents were recruited via snowball sampling of members of the research group, messages on the websites of partners and social media, a branch organization of nature coaches and via an exchange platform where students get respondents for their own surveys (SurveySwap). Initial analyses indicated that responses of three respondents were unreliable, because they completely agreed or completely disagreed with both the item "I never get bored with nature" and a trick-item "I easily get bored with nature". These three respondents were removed from the dataset.

The final sample of 87 respondents consisted of 67 females and 18 males, and three respondents who preferred not to disclose their gender. The mean age was 37 years, with the youngest respondent being 12 and the oldest 72.

Iterative exploratory and confirmatory factor analyses were conducted for each dimension to select a subset of 36 items, with 9 items per dimension and 3 items per competency (see Appendix B for an overview of the selected items with factor loadings). The 36-item scale showed good reliability, with

Cronbach's alphas of .94 for the entire scale, .72 for the Cognition dimension, .82 for the Emotion dimension, .85 for the Spiritual dimension, and .86 for the Action dimension.

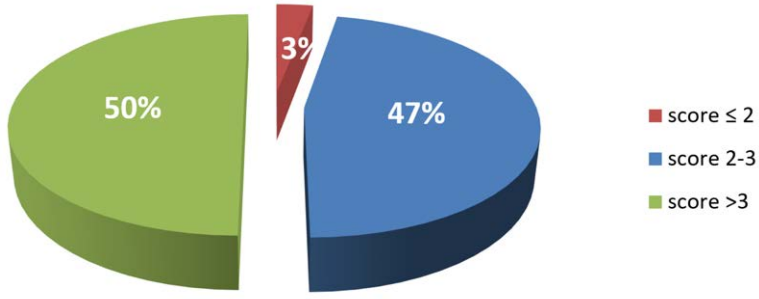
3.4 Statistical analysis

Preliminary statistical analyses were conducted to get an idea of the range and distribution of the scores across domains and competencies, and to establish the scale's sensitivity to gender and age differences. For interpretation, please remember that the response options were 0 = totally disagree, 1 = disagree, 2 not disagree, not agree, 3 = agree and 4 = totally agree. Thus, the midpoint of the scale is 2.

Overall scores

The mean overall score on the 36-item scale is 2.89 (with a lowest mean score of 1.17 and a highest mean score of 3.69). About half of the respondents have a mean score equal to or higher than 3. In the group with mean scores lower than 3, only 3 respondents (3%) have a mean score lower than 2. Thus, in general, the sample scored relatively high on NQ, with mean scores above the midpoint of the scale. This may reflect the fact that many respondents in the convenience sample were professionally or otherwise involved in nature-based activities.

Figure 3.1.
Distribution of mean scores on the NQ-36 scale



For the subsequent analyses, mean scores on the total 36-item NQ scale and its dimensions and competencies were divided into high and low levels, with scores below 3 representing a (relatively) low level of NQ (with much room for improvement) and scores equal to or higher than 3 representing a high level of NQ (with little room for improvement)

As shown in Figure 3.2 below, respondents have relatively low scores in the cognitive domain (67% low scores) and emotional domain (55% low scores), while they have relatively high scores in the spiritual domain (43% low scores) and action domain (44% low scores). However, scores differed considerably across the competencies within the four domains.

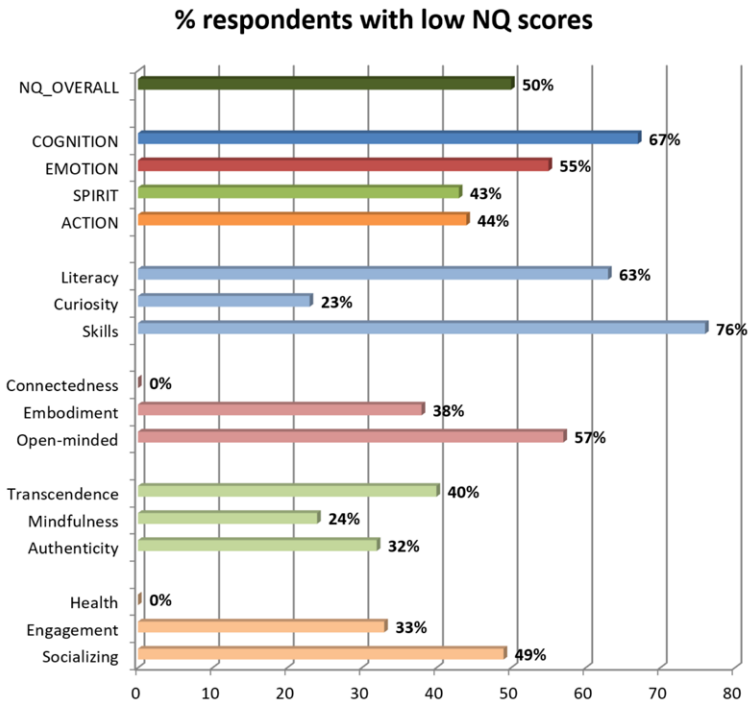


Figure 3.2.
Percentages of respondents with low scores on the NQ-scale and its domains and competencies.

Within the cognitive domain, respondents generally showed a high curiosity for nature, with only 23% low scores. The opposite was, however, true for practical outdoor skills: the majority of respondents (73%) score poorly on this competency. They also show relatively low levels of nature literacy (63% low scores).

Within the emotional domain, all respondents score high on connectedness, there were no respondents with low scores. Most respondents also felt comfortable about making direct physical contact with nature in an embodied manner, only 38% felt uncomfortable doing so. The lowest scores in the emotional domain are found for open-mindedness. More than half of the respondents (57%) have a low score on open-mindedness, indicating a tendency to respond with disgust or discomfort to more negative sides of nature.

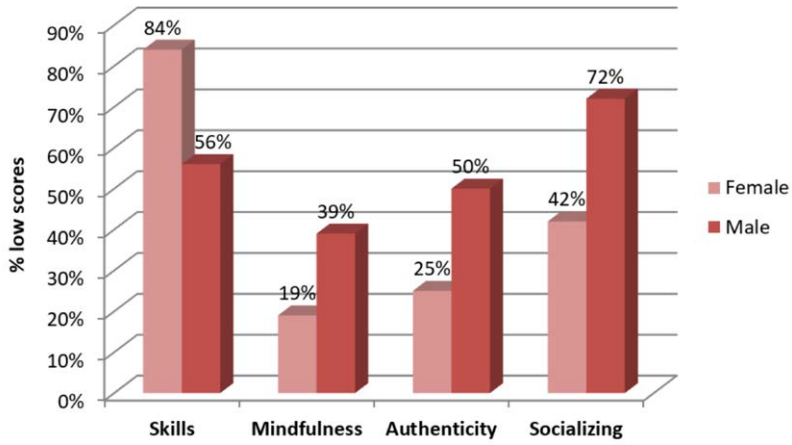
Within the spiritual domain, respondents generally show a high level of mindfulness, only 23% have low scores on this competency. They show somewhat lower levels of transcendence (40% low scores) and authenticity (32% low scores), but still the majority of respondents feels competent in these domains.

Within the action domain, all respondents score high on the competency to use nature for their health, there were no respondents with low scores. The majority of respondents also have high levels of engagement, only about one-third (33%) have a low level of engagement. Respondents show less competence in the ability to use nature for socializing, about half of the respondents (49%) score low on this competency.

Gender differences

Female respondents (*N* = 67) generally show higher levels of competencies in the emotional, spiritual and action domains than male respondents (*N* = 18). Male respondents score somewhat better in the cognitive domain. These differences are significant for the competencies of mindfulness, authenticity, socializing, and practical outdoor skills. Figure 3.3 gives an overview of the percentages of male and female respondents with low scores for each of these competencies.

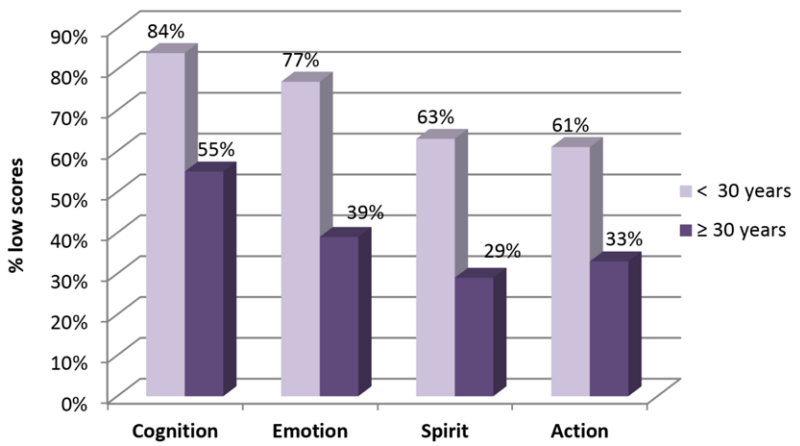
Figure 3.3.
Gender differences in percentages of respondents with low scores.



Age differences

As illustrated in Figure 3.4, respondents younger than 30 years (N = 38) generally show significantly lower levels of competencies than older respondents (N = 49). These differences are significant for each of the four domains, and for all competencies, except for the competency to use nature for socializing. Although the difference is not significant, there are somewhat less respondents with a low score on socializing (47%) in the younger group than in the older group (51%).

Figure 3.4.
Age differences in percentages of respondents with low scores.



User evaluation

3.5

As a final step, the appropriateness of the selection of 36 items for the target group of young people was tested in a session with 20 young people (age 23-32, 7 males). The evaluation session was organized by a group of three master students of the Vrije Universiteit Amsterdam, the Netherlands, as part of a course fulfilment. Participants were recruited by the students through peer-driven sampling.

Before the session, participants received a draft copy of this report and a link to a 36-item version of the online NQ survey. The session, which was held via an online meeting, aimed at obtaining user feedback on each of the 36 items. Participants were encouraged to share their experiences when answering the question, and to give suggestions for improvement. All comments made by the participants were written down and evaluated for their relevance by the students.

Based on the user feedback, the students made recommendations for reformulation of the items. Most of these recommendations related to language issues (e.g., the suggestion to change the item "When I feel stressed or down, being in contact with nature makes me feel better" with "When I feel stressed or down, doing something in nature makes me feel better". Participants also indicated that some items were formulated too strongly (e.g., "Protecting nature and the environment is a guiding principle in my life", which was changed into "Protecting nature and the environment is an important principle in my life").

In general, participants indicated that the items chosen were representative of the dimensions and competencies. However, with regard to the 'skills' competency (in the cognitive domain) they noted that two items were about wayfinding and orientation skills, and that it would be good to replace one of these items with another skill. Following this advice, the item "When in nature, I usually have a pretty good idea of where north, south, east and west are" was replaced with "I am able to apply my knowledge about nature in my daily life, for example growing food or searching for food in the wild". With regard to the 'mindfulness' competency (in the spiritual domain), participants suggested to replace the item "It feels like I lose all sense of time when I am in nature" with "Nature helps me to keep track of my thoughts and feelings".

Final NQ-36 scale

3.6

Table 3.2 gives an overview of the final version of the NQ-36 scale. Compared to the version that was used for the psychometric and statistical analyses (as given in Appendix B), some items have been rephrased based on comments from a proofreader and insights that emerged fromthe user evaluation session.

Table 3.2.
The NQ-36 scale

Cognitive Dimension		
Literacy	1	I can identify many things in nature like animals, plants, and stones/logs etc.
	2	I can recognize and understand processes, patterns and cycles in nature.
	3	I possess specialized knowledge about a specific aspect of nature like birds, edible plants, and fossils.
Curiosity	4	I am interested in information about nature, like watching nature films/ documentaries, reading books or articles.
	5	I am intrigued by how everything in nature seems to be interconnected.
	6	I am fascinated by Nature's beauty and the experiences it provides.
Skills	7	I am able to apply my knowledge about nature in my daily life, for example growing food or searching for food in the wild.
	8	I don't get lost in nature easily.
	9	I possess nature survival skills such as starting a fire, finding food, building a shelter for sleeping etc.
Emotional Dimension		
Connectedness	10	I think of the natural world as a community to which I belong.
	11	I care deeply for living beings: animals, plants or mushrooms.
	12	I think that animals, plants, and humans are all interrelated.
Embodiment	13	I am not bothered if I get wet or muddy when in nature.
	14	I like to walk barefoot outdoors.
	15	I enjoy digging in the earth with my bare hands.
Open-mindedness	16	I can stand the sight of dead birds or other small animals in nature without feeling uncomfortable.
	17	I would be fine with spending a day in nature without toilets or other facilities.
	18	I would rather not kill flies or other insects.
Spirit Dimension		
Transcendence	19	Even everyday nature settings are full of complexity and beauty.
	20	I have an open mind to the spiritual meaning of things in nature.
	21	I feel that all inhabitants of earth, human and other organisms, share a common 'life force', 'energy', or 'soul'.
Mindfulness	22	When in nature, I feel in touch with the here and now.
	23	Nature helps me to keep track of my thoughts and feelings.
	24	Nature enhances my awareness of sensations like smells, sounds and the wind on my face.
Authenticity	25	Nature inspires me to stay true to myself and live according to my values and beliefs.
	26	When in nature I feel free to express my personal opinion.
	27	Nature inspires me to reflect on the meaning of life.
Action Dimension		
Health	28	If I want to feel refreshed and energized, I take a trip to nature.
	29	When I feel stressed or down, doing something in nature makes me feel better.
	30	Natural surroundings help me more to sort out my feelings than urban surroundings do.
Engagement	31	I am concerned about the climate and the environment.
	32	I pay attention to my consumption habits out of respect for nature and the environment.
	33	Protecting nature and the environment is an important principle in my life.
Socializing	34	Being surrounded by nature makes it easier to engage with other people.
	35	I like to participate in activities in nature with others.
	36	I seek out parks or other natural settings as a place to chill out with friends.

Limitations

3.7

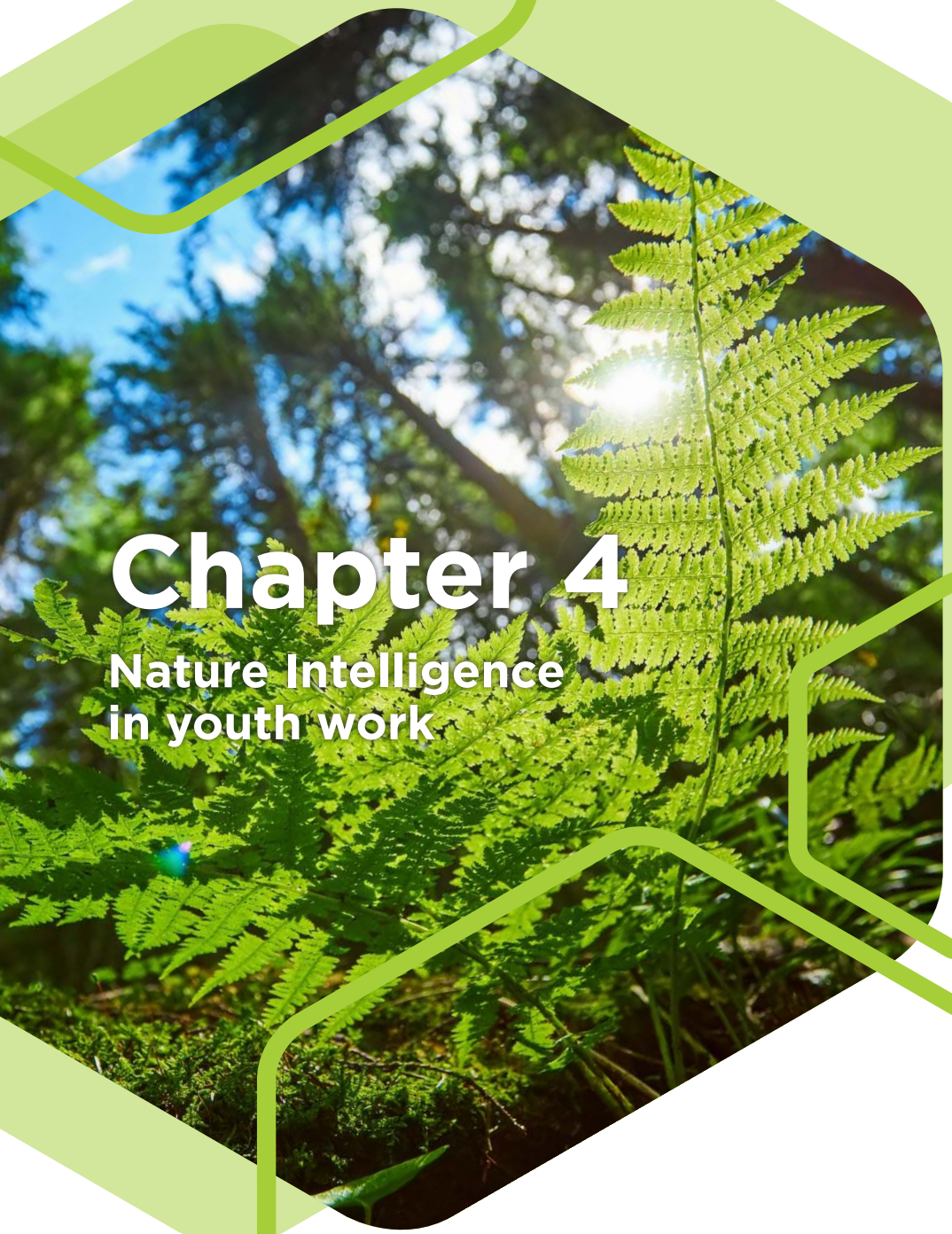
This chapter described the development of a scale to measure NQ. Starting from an initial set of 60 items, a final scale of 36 items was selected by means of psychometric analyses and a user evaluation. Psychometric analyses using data from a convenience sample of 87 respondents confirm the usefulness of distinguishing between different domains of NQ and different competencies within these domains.

There are several issues that need to be considered when using the scale. For one thing, the validation of the scale was carried out with a convenience sample that only partly matched with the target population of young people. By including older respondents, it was possible to check for differences between age groups, to which the scale showed high sensitivity. However, it is possible that a psychometric evaluation of the scale among only young people would have yielded different results.

Furthermore, the factor analyses were conducted separately for each of the four domains. Apart from the fact that the sample was not large enough to include all 60 items in one factor analysis, it was also considered undesirable that items that theoretically belong to a certain domain would “cross-over” to another domain. Thus, the four dimensions of the NQ scale are based on theoretical considerations, the postulated four dimensions were not statistically confirmed.

Another issue of concern is that some items in the final version of the scale as presented in Table 3.2 were rephrased after the psychometric analyses, based on feedback from the target group of young people. The psychometric properties of the final scale will be examined in further rounds of testing and validation, which are reported on separately from this report. In general, it should be kept in mind that the NQ-36 scale is still under development. If future evaluations warrant further revision, the latest version of the scale will be published on the website natureintelligence.eu.

Finally, when using the scale, please keep in mind that the idea behind the concept of NQ is that it provides a means to gaining a better understanding of one’s relationship with nature. There are no good or bad types of relationship with nature. And thus also no good or bad scores. The scores on the NQ scale only provide insight into potential directions for strengthening certain aspects of one’s relationship with nature.



Chapter 4

Nature Intelligence in youth work

How can youth organizations encourage the development of Nature Intelligence? NQ being a new concept, there is presently no research on the effectiveness of programmes specifically aimed at developing NQ in young people. However, the literature on environmental education provides many insights on the critical success factors that are relevant to developing skills and competencies related to the cognition, emotion, spiritual and action dimensions of NQ.

This chapter begins with a short introduction on environmental education, followed by a discussion of studies that shed light on the critical success factors relevant for promoting various aspects of NQ in each of the four domains. The chapter concludes with a summary of the most relevant critical success factors, which are of practical significance for the Nature Intelligence curriculum design developed under intellectual output 2 of this project.

Environmental education 4.1

Environmental education is a broad umbrella term that refers to organized efforts to teach the relationship between humans and the natural environment. Within this multidisciplinary field, two perspectives can be distinguished: the perspective of *nature education* as a way of teaching a better understanding of nature, and the perspective of *education for sustainable development* as a means of promoting pro-environmental behaviour. While the two perspectives are related (a better understanding of nature will inspire more sustainable behaviours), there are also differences, nature education being mostly focused on promoting 'individual well-being', and education for sustainable development being mostly focused on 'saving the planet'. The concept of NQ aims to integrate both perspectives.

Environmental education has shifted over the years, from a more cognitive focus on plant and animal identification and memorizing facts about nature, to a more experiential approach that involves teaching students through hands-on experiences with nature. However, the idea of hands-on or experiential learning dates back to as early as the 1880s, when John Dewey started the Progressive Education Movement as an alternative teaching practice that emphasized students' individual growth and development through increased autonomy inside and outside the classroom. Kurt Hahn, a 20th-century German educator, advocated that a full education requires the utilization of outdoor recreation such as land or sea expeditions [36], stating that "Experience has taught us that expeditions can greatly contribute towards building strength of character". Hahn was one of the founding fathers of the Outward Bound Schools (or programmes), which can nowadays be found in many countries worldwide. These schools are inspired by Hahn's principles, which among other things, include:

- **The primacy of self-discovery.** Learning happens best with emotion, challenge and the necessary support. People discover their abilities, values, passions, and responsibilities in situations that offer adventure and the unexpected. In Outward Bound programmes, students undertake tasks that require perseverance, fitness, craftsmanship, imagination, self-dis-

cipline, and significant achievement. A teacher's primary task is to help students to overcome their fears and discover they can do more than they think they can.

- **The having of wonderful ideas.** Teaching in Outward Bound schools fosters curiosity about the (natural) world by creating learning situations that provide something important to think about, time to experiment, as well as time for making sense of what is being observed.
- **Solitude and reflection.** Students and teachers need time alone to explore their own thoughts, make their own connections, and create their own ideas. They also need time for sharing their reflections with others.

4.2 Encouraging cognitive competencies

A seminal review by Dillon, Rickinson and colleagues provides an overview of 150 studies in the field of outdoor education, aimed at school children as well as adolescents and young adults [37]. Though published in 2006, it is still one of the most cited reviews in this field, and unlike many other literature reviews, it is not limited to exclusively American or Australian research as studies from Europe and other parts of the world are also included.

The review distinguishes several critical success factors that determine the effectiveness of outdoor education in promoting environmental knowledge, positive attitudes and behaviour as well as practical skills. These success factors include programme characteristics as well as characteristics of the participants.

Programme characteristics:

- **Duration.** Effects are generally stronger the longer a programme lasts [38].
- **Preparation and follow-up.** Good preparation (by means of lessons, meetings, etc.) strengthens the effects [39], a good follow-up ensures that the effects last longer [40].
- **Careful design.** Programmes should not be overly structured. Assignments like note-taking, filling in work sheets and writing reports are unpopular among students, and do not appear to contribute much to environmental learning [41].
- **Support from peers and instructors.** Students' learning is facilitated by shared experiences with peers about the surroundings, as well as teachers' role modelling of their interests and likes of nature [42].

Participant characteristics:

- **Age.** Primary school-age students are generally more enthusiastic and receptive to outdoor education than adolescents or secondary school students.
- **Gender.** Girls tend to respond differently to outdoor education than boys. Among other things, they have a greater need for social acceptance and only when this need is met can they open to adventure.
- **Fears and phobias.** Especially for outdoor learning, exaggerated fears about nature and phobias of the participants can hinder the occurrence

of learning effects. Addressing such fears is an important requisite for the success of a programme [43]; [44].

- **Learning style and preferences.** Some students enjoy being taken by the hand; others prefer to go out on their own. If the design of the programme does not take into account these individual preferences, it can be a hindrance.

Encouraging emotional competencies

4.3

As most professionals who work with youth and nature know from their own experience, interest in nature varies across people's lifespan, with both the youngest and the oldest groups being most connected to nature. This practical knowledge was confirmed in a recent survey among 3568 adults aged 16 to 95 years old [45].

Using a short, 6-item measure of nature connectedness, it was found that scores on nature connectedness peaked in early childhood (up two 12 years), with a sharp dip in connection with nature into the teenage years, followed by a slow recovery as people grow into adulthood (see Figure 4.1 below).

The dip in nature interest and connectedness in adolescence can be attributed to an increased involvement with schoolwork in combination with hormonal changes, which cause teens to be more interested in connecting with their peers than in connecting with their environment. Given the presumable biological origins of the dip in nature connectedness among youth, one may ask whether it is a realistic aim to stimulate nature connectedness, and thereby nature intelligence, in this age group.

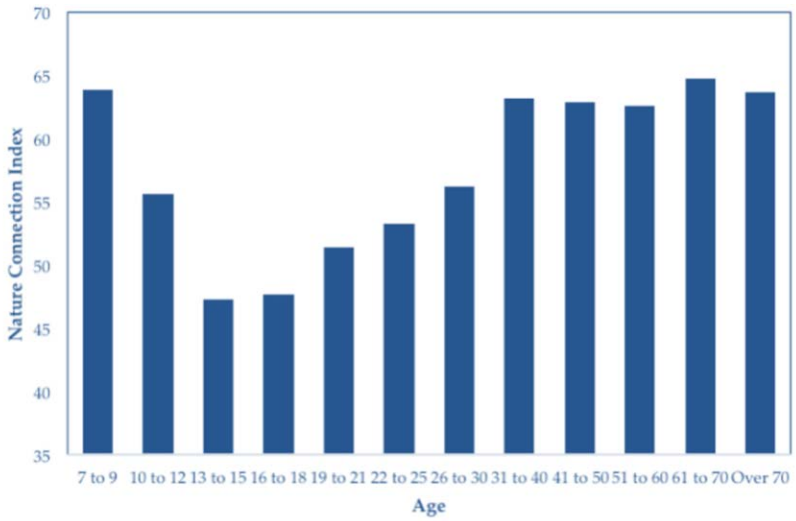


Figure 4.1. *Mean nature connectedness scores across the lifespan (reproduced from Richardson et al., 2019[45])*

A study among 130 adolescents from the UK who participated in 5-11 days wilderness programmes across the world revealed significant increases in both self-reported nature connectedness and self-esteem as a result of single expeditions46. This study suggests that outdoor programmes for youth can be effective in strengthening connections with nature. The authors suggest that, in addition to programme characteristics (as discussed in the previous section), wilderness settings, due to their challenging and unspoiled character, provide a highly supportive context for strengthening connectedness with nature.

The importance of the type of natural setting for strengthening connections to nature is corroborated by a large survey (N = 4515) in England [47]. In this survey, people were asked to recall a recent visit to nature and to indicate how close they felt to nature during that visit. Results showed that people reported greater connectedness to nature following visits to more pristine nature reserves, rural settings and coastal locations in comparison to urban green spaces.

A field study among urban youth (N = 36, age 14-19) gives a more concrete insight into young people's experiences with an outdoor nature programme [48]. On the negative side, urban youth associated nature with fear and danger; dirt, disgust, and discomfort; and physical endurance and challenge. On the positive side, they associated nature with fun and enjoyment, a contrast with everyday life, and a place that deserves respect. As a critical success factor, becoming more experienced with nature helped shape positive views, a realistic understanding of risks, and a greater appreciation of nature. As such, findings support the importance of continued, direct contact with nature, particularly for urban youth with limited experience in outdoor settings.

4.4 Encouraging spiritual competencies

Spirituality in nature is closely related to having 'peak experiences' that make a strong impression and have a long-lasting influence throughout the person's lifespan. Different types of peak experiences with nature can be distinguished in the literature, including flow experiences [49]; [50], significant life experiences [51], sublime experiences [52], and magical moments [53]. A common element in all these experiences is that they are deeply touching, forming experiences that mostly happen in childhood and that often contain an element of anxiety and fascination and may permanently change a person's vision of life. Table 4.1 summarizes the characteristics of these various peak experiences and the social and physical circumstances that support these experiences [54]; [55].

	Flow experiences	Significant life experiences	Sublime experiences	Magical moments
Examples	Making a dam in a river, building a shelter, taking care of an animal	Getting lost in the forest or a confrontation with a (wild) animal.	Enraptured by the majestic beauty of large trees or mountains	Intrigued by the beauty of a flower or animal or the growing process of a seed.
Psychological state	Synergy of mind, senses and body. A deep focus and concentration.	Conquer you fears, feeling of mastery.	A mix of arousal, pleasure, and vitality, together with feelings of awe in nature	Being grasped by something that you've never sensed before.
Social context	Alone, preferably without peers or adult supervision.	Alone or with peers. Adults can function as a role model.	Alone or shared with peers or adults. No supervision by adults	Alone or with adults. Adults can facilitate by guiding attention.
Availability of nature	Proximate and easily accessible nature	Access and accessibility to nature, preferable wild nature areas.	Dramatic, impressive settings (seas, mountains, forests, clouds)	A rich sensory nature environment,

Table 4.1.
Types of peak experiences with nature, adapted from Verboom and De Vries (2006)[55].

A study among Dutch school children provides some insight into children's peak experiences with nature [56]. In this study, children (age 8-10) were observed while they participated in a three-day experiential nature programme called *The Preserved Land*. There were several observations of individual peak experiences, such as magical moments, during which a child became fascinated by the sight of a frog, a beetle or other natural phenomenon, or flow experiences, that occurred when a child was totally absorbed in an activity that requires a certain amount of concentration and effort in it's execution. These individual peak experiences were most powerful when children were supported by a didactically strong educator who guided the children step by step in confronting their fears and having confidence in themselves. In addition to these individual experiences, there were also many examples of group peak experiences, during which the children seemed to become totally absorbed in the pleasure of spending time together with their peers in nature. Examples are swimming together in the pond and making fire together. Group peak experiences seemed to be more important for immigrant children with little nature experience than for native Dutch children. As such, these experiences could be a first step towards achieving deeper levels of spirituality.

4.5 Encouraging the use of nature for health

There is increasing evidence that contact with nature can promote health and well-being [57]. Within this field, two lines of research are of particular importance to the current project: (1) research on the restorative, or stress-relieving functions of nature, and (2) research on the therapeutic benefits of nature-based interventions.

Restorative environments research

Restoration is an umbrella term that, within environmental psychology, refers to a wide array of pleasant and beneficial experiences with natural environments [58]; [59]. Among other things, restorative experiences include recovery from self-reported and physiological stress, reduced anxiety, improvements in mood and vitality, and enhanced attentional functioning. While most research on restorative effects of nature has been conducted with adults, there are indicators that young people also use and appreciate nature for its restorative capacities.

A recent study with young multi-ethnic urban residents (17-27 years) living in a northern UK city explored the value of urban nature for the mental health and well-being for this age group 60. The study used free "arts workshops" with mixed creative activities (e.g., collages, drawing, making photos, free writing, mood boards) as a means to collect information about participants' experiences with urban nature. This method was found to be a useful means for young people to express their ideas about nature, which are often difficult to verbalize. Young people expressed how encounters with trees, water, open spaces and views were experienced as accepting and relational, offering a stronger sense of self, feelings of escape, and connection with and care for the human and non-human world. Participants also experienced barriers to using nature for restoration and well-being, including not feeling safe in urban parks (e.g., because of litter or anti-social behaviours of other visitors), and not having friends or family to visit nature with.

In general, research indicates that restorative experiences are most likely to occur in pleasant, unthreatening settings that enable 'clearing the mind' from work or school obligations [61]-[64]. This makes restorative experiences fundamentally different from spiritual or more sublime experiences, which typically include an element of challenge and confrontation with one's fears and struggles in life. Importantly, and possibly even counterintuitively, giving participants 'mindful' instructions to *open up* to the environment and take it in with all senses, by means of breathing exercises or other assignments, seems to reduce rather than enhance the restorative effects of nature. For example, an experimental study with Dutch students showed that combining exposure to a (virtual) natural environment with a breathing exercise was less effective in promoting feelings of happiness than mere exposure alone. In other words, the breathing exercise seemed to 'spoil' the spontaneous joyful feelings that

come with visiting nature. This suggests that, to facilitate restoration, programmes need to incorporate "free time" in nature, allowing participants to just sit, relax and enjoy the natural surroundings without putting too many demands on their cognitive resources.

Notably, being surrounded by nature can enhance the effectiveness of mindfulness training by mitigating some of the cognitive effort involved in acquiring mindfulness skills [65]; [66]. Moreover, starting day trips to nature with meditation exercises in the morning has found to strengthen connectedness to nature [67]. Thus, there are positive gains of combining nature experience with mindfulness exercises, in the sense that it supports people to become more mindful and connected to nature. However, this may come at the cost of the nature experience becoming less restorative.

Therapeutic nature programmes

There is a wealth of research on the beneficial effects of wilderness therapy, therapeutic camping, adventure education and other programmes for child and youth care [68]; [69]. In these programmes, the natural environment is used as therapeutic agent to improve the health and well-being of youth who are at risk of developing mental health problems, or who are already having such problems. Youth participating in these programmes experience, sometimes for the first time in their lives, the beneficial effects of nature, and are encouraged to make more use of nature for their health and well-being. As such, insights from research on therapeutic outdoor programmes are also relevant for getting youth acquainted with the beneficial effects of nature and stimulating them to use it for their health and well-being. For example, a list of "elements of practice" as distinguished by Harper [70] suggests several critical success factors that may be helpful to make young people become conscious of, and use, the beneficial effects of nature:

- Encourage **active bodily engagement** with nature through experiential learning
- Establish a **connection to place**, stimulating place-based identity, by providing place-based knowledge
- Generation of **metaphors**, showing students that nature provides an unlimited opportunity for meaning making, analogy, and narratives
- **Challenging students to take risks** to support personal growth, while at the same time acknowledging fears and other constraints
- Make time for periods of **reflection and inactivity** and guided 'alone time' that allow introspection
- Focus on **activity and social dynamics** rather than through discussion (i.e., talk therapy).

Most therapeutic nature programmes are carried out in a group setting. A recent meta-analysis based on 36 studies of group programmes (including 2399 participants, mostly adolescents) found medium effect sizes for all six outcomes included in the analysis: self-esteem, locus of control, behavioural observations, personal effectiveness, clinical measures, and interpersonal measures71. The results also show stronger positive effects

on most outcomes for open groups (with constant influx from new members) than for closed groups. Closed groups were, however, more effective in promoting self-esteem. Applied to youth who want to use nature for their health and well-being, it seems, in general, better to participate in an open group of peers to share nature experiences with. However, if building self-esteem is an issue, then it seems better to experience nature within a closed group.

Young people nowadays seem to be *glued* to their smartphone, iPad, or computer. Most of their interactions take place in a virtual world, and it is a challenge to draw them out of their virtual bubble and into the real world. A study among German youngsters aged 13-20 who participated in a 10-day adventure nature programme in France [72] shows that young people who spend a lot of time on screens benefit the most from such a programme. Young people with more than 3 hours of screen time per day were less satisfied with their lives at the start of the programme than young people with less screen time, and after the programme their satisfaction had risen to the same level as the young people who spend little time on screens.

4.6 Encouraging the use of nature for pro-environmental behaviour

How do adults look back on the influence that childhood experiences with nature had on their lives? This question was addressed by Wells and Lekies in a ground-breaking article in which more than 2000 American adults were interviewed with respect to their childhood experiences with nature and their current adult behaviours and attitudes towards the environment [73]. Results show that childhood participation in activities in 'wild' nature, such as hiking or playing in the woods, camping, hunting or fishing, as well as participation in 'domesticated' nature activities such as picking flowers or produce, planting trees or seeds, and caring for plants in childhood, have a positive relationship to adult pro-environmental attitudes. Interestingly 'wild nature' participation was more positively associated with environmental behaviours than participation in more "'domesticated nature' experiences.

A study in the Netherlands evaluated the impact of 50 years of 'Savage Land' youth camps organized by nature organization IVN, by means of a survey among more than 300 former youth camp members [74]. The results provide a unique insight into participants' experiences, and how these experiences influenced their lives. Participants recollect the camps as a life-changing experience, both in terms of personal growth as well as in establishing social relations, making environmentally conscious choices and pursuing a career in "green" professions. The findings of this study suggest several critical success factors of the programme in promoting engagement with nature and pro-environmental behaviour, which mostly relate to reaching the youth population of interest more effectively:

- **Networking.** Using the social networks of friends and relatives of present or previous participants more effectively.

- **Collaboration.** Establishing collaborations with other organizations operating in the field of environmental and ecological issues in order to reach new audiences.
- **Communication.** Sending clear messages about the programme's profile and offer clear information about the activities.
- **Selling points.** Emphasising the main selling points: the sense of family, the joy of working outdoors with others, the unique locations, and possibly even the low financial cost of such a holiday.
- **Share experiences.** Communicating that the camps provide awesome experiences and lifelong memories.

Encouraging the use of nature for socializing

4.7

As discussed in paragraph 4.3, interest in nature and connectedness with nature tends to be very low during the teenage years. In line with these findings, a qualitative study in the UK amongst 16–18 year olds found that many teenagers reported both negative attitudes towards visiting nature and negative experiences whilst in natural environments [75]. However, this only applied to solitary nature experiences. Being with a friend transformed these negative attitudes and experiences into positive ones. A follow-up field experiment with 120 16–18 year olds confirmed the importance of visiting nature with friends for adolescents [76]. The findings show that visiting nature unaccompanied had a slightly negative impact on participants' mood, while visiting nature with a friend had a strong positive impact. Being with a friend also made staying in an indoor environment more pleasurable. However, the positive, buffering impact of a friend was much stronger in the outdoor natural environment.

The findings of the UK studies suggest that being with a friend can improve adolescents' experience of nature. But can being in a nature environment also improve the quality of social contacts? A study among adults suggests that this might indeed be the case [77]. Pairs of friends were randomly assigned to 15 min of pedalling on an ergometer placed either outdoors in a natural environment, or indoors, in a laboratory setting. It turned out that social interaction time was significantly greater during outdoors exercise versus indoors: on average, participants engaged in a further three minutes of social interaction (visual and verbal) during exercise outdoors compared to indoors.

Common themes

4.8

In this chapter, critical success factors for encouraging NQ were identified through a review of research in various domains relevant to NQ. Across the domains, the review yields five recurrent themes and common factors, which are summarized below.

- **Active bodily engagement with nature.** In line with prevailing experiential (hands-on) approaches to environmental education, direct physical

and sensory contact appears to be a key success factor in developing competencies in each NQ domain.

- **Free time in nature.** For all competencies, it is important that young people discover and interact with nature in a free, self-guided way. Overly structured programmes can result in considerable participant discontentment and reduce opportunities for students to develop their coping skills and experience magical moments. Moreover, the inclusion of too many guided activities places a heavy demand on cognitive resources which can diminish the spontaneous joyful feelings that come from being in nature.
- **Balance between social and individual activities.** Particularly for adolescents, being surrounded and supported by peers is an important aspect of experiencing nature. However, while group activities are generally suitable for encouraging competencies in all NQ domains, there should also be time for periods of individual reflection and introspection. Spending alone time in nature is especially important for the occurrence of peak experiences, which are critical for establishing a connection with nature.
- **Addressing excessive fears.** Across all domains, exaggerated fears about nature and phobias can hinder the development of competencies. If a person experiences excessive fears towards nature or a nature experience, participating in a nature-based programme may not be beneficial or appropriate. Addressing such fears (for example, through guided exposure to fear-evoking elements and situations) is an important requisite for encouraging NQ.
- **Diversity of environments.** Youth programmes are often held in wilder natural areas, outside of the city. These environments are highly suitable for developing outdoor skills and for stimulating pro-environmental behaviour and competencies in the spiritual domain. However, some competencies, particularly the ability to use nature for relaxation and socializing, are better supported by closer, familiar, unthreatening types of nature. In order to encourage NQ in all domains, the recommendation seems to be to bring youth in contact with various types of natural settings, including green spaces near home, so they can learn to regularly use these spaces for their health and well-being as well as socializing.

Conclusion

This report provides the background and theory for promoting Nature Intelligence (NQ) in the European youth sector. Based on a review of the literature and input from partner organizations, NQ was conceptualized as a multidimensional concept that describes young people's relationship with nature in terms of four domains of competencies: Cognitive competencies (Literacy, Curiosity, Skills), Emotional competencies (Connectedness, Embodiment, Open-Mindedness), Spiritual competencies (Transcendence, Mindfulness, Authenticity) and Action competencies (use of nature for Health, Engagement, and Socializing). The four domains of competencies can be graphically represented in a flower model, with NQ in the heart of the flower as an emergent property.

A scale for measuring NQ was developed in three steps. Firstly, an initial pool of items representative of the competencies was generated from relevant pre-existing scales and theoretical insights. Secondly, the initial item pool was evaluated, discussed and adapted by the partner organizations during a workshop. Thirdly, a final scale of 36 items was constructed based on results of a survey among a convenience sample of younger and older respondents from different backgrounds. The scale showed good reliability and psychometric analyses confirmed the usefulness of distinguishing between different domains of NQ and different competencies within these domains. The NQ scale can be used in youth work in various ways. Among other things, the scale can be used to gain insight in participants' initial levels of competencies at the start of a programme, and to evaluate the effectiveness of a programme or activity in promoting NQ.

Critical success factors for encouraging NQ were identified through a review of research in various domains relevant to NQ, including research on environmental education, connectedness to nature, peak experiences, restorative environments research, nature-based therapies and pro-environmental behaviour. Across the domains, the review yielded five common critical success factors: active bodily engagement with nature, free time in nature, a balance between social and individual activities, addressing excessive fears, and exposing participants to a diversity of environments, including green spaces near their living environment.

In sum, NQ appears to be a useful concept for capturing the manifold relationship of young people with nature as a starting point for enriching and fostering that relationship, and for improving their competencies in using nature for their own mental health and wellbeing, as well as the health of the planet and its ecosystems.

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Appendix A: Descriptions of persons with a high NQ

1. CZ

Renata walks alone through the forest with her backpack. Following an old path, she feels that this is the right direction. Listening to birds and trees, sensing the river down in the valley, touching stones along the way and breathing air full of flowery scents makes her almost dissolved in the surrounding. She gathers some herbs for the evening tea and collects rubbish along the path. In the camp, she will build her shelter, help with starting a fire and cook dinner together with friends who met at spot near the pond. Together they are on a pilgrimage. Every year Renata celebrates her birthday by walking, with an intention, through landscape and time. Later in the evening there will be a midsummer ceremony. The fire will unfold a story for everyone. Marking important moments of the year and celebrating changes in life is Renata's new practice. She feels at home in the forest and collecting firewood is a cosmic experience for her.

2. IVN

The person described is not a real person, but has a mixture of traits of various people we have worked with in the past and present to give a most complete example of qualities we associate with NQ. For this example we will call her Laura. Laura is a very authentic person, very open to new people and experiences. She cares deeply for all living beings and strives to live in balance with her natural surroundings. You might describe her as a bit altruistic. She is very intuitive, curious, and has the ability to notice the different possible perspectives and interconnections of her surroundings. She feels re-energized and calm after being in nature, both in active ways (e.g climbing rocks) and slow ways (enjoying her food outside gratefully). Youth work can help her by allowing her to do activities outdoors, especially if that is not particularly encouraged within her own social bubble. This social time in nature will result in Laura feeling more at home within herself, society and the world, as well as developing into a balanced adult.

3. Kamaleonte

Cristiano is a 23 year old young person who lives in a small town close to both the seaside and the forest. His father had a passion for fishing and today, unlike other young people his own age, he spends most of his free time in the sea, fishing no matter the weather conditions or season. In rain or heat, high waves or a calm sea, for him the sea is always attractive. To him, fishing means being in peace and in contact with himself, as well as being in harmony with the natural environment. He likes the fact that fishing is a challenging

activity that requires him to think about new strategies, to understand the fish's behaviour. Some pleople, particulaly environmental protectors, might think that Cristiano has an anti-ecological behaviour and is far from having a naturalistic quotient. However when Cristiano returns home with his seasonal catch of the day, he also brings with him a bag full of plastic and general waste he collected from the shore, as he wants the beach to remain clean. Moreover all the waste that is recyclable, he either reuses it himself or takes it to the recycling bin. His NQ also manifests in his perceptiveness towards all the natural phenomena and objects that he encounters on the beach. In fact, Cristiano collects a lot of natural materials, such as planks and shells, to create sculptures and art craft that he offers to friends. There are many elements in Cristiano's behaviour, ways of thinking and of being with himself that makes us think that he has a high NQ. The fact that he lives only 10 minutes' walk from the beach and that he spends most of his time there, shows us how deep his relation to nature is and how the sea makes him feel good and content about what he does. Cristiano is attracted to the sea because of its beauty. He likes all aspects of it, including the slimy consistency of the worm he uses for fishing. He likes to touch the scales of fish and has no problem cleaning them or smelling them. His care for nature also emerges in the woods where he picks mushrooms and soil with the same respectful yet very natural attitude. When he picks up a mushroom or another plant (that he eats with pleasure), he is aware of the right moment to harvest it, and he makes sure to cut the mushroom instead of tearing it from the soil, so it can grow again in years to come. Cristiano does not only contemplate nature, feeling regenerated after having walked through the forest or by the shore. He likes to be challenged by nature and feels he learns a lot about himself and how to regulate his emotions by experiencing life in close contact with nature.

Cristiano thinks that nature has contributed to his personal development. He has learnt how to get out of his comfort zone and find courage within, how to be independent, how to face unpredictable events such as the risk of drowning and how to deal with the uncertainty of being caught in rough waters.

He feels that nature has contributed to developing a sense of beauty within and impacted his capacity of being creative.

Cristiano is also a very healthy person and, despite the weather conditions, he hardly gets sick. His body indeed benefits from moving and from breathing iodine and phytoncides (essential oils), antimicrobial volatile organic compounds derived from trees. These contribute in increasing the level of serotonin and lower the production of stress hormones, having a greater impact also on his immune system.

Nature has indeed helped Cristiano feeling his strength rather than simply thinking about his strengths.

What is admirable about Cristiano is his way of "being" in nature and his drive to being challenged out of sincere interest. To him, nature offers stimuli and the possibility of achieving goals. The natural environment activates in Cris-

tiano a positive arousal as well as the will to confront himself and to learn from his physical and emotional pitfalls.

What youth work can do for young people like Cristiano is to offer them the opportunity to have outdoor experiences together with peers, reflect upon those collectively and share their insights. Such experiences could enable young people to become positive influencing positive role models for peers.

4. Ambitia

The person with a high nature intelligence as I imagine it, does not exist. The first person that comes to mind is a fictional character from my favourite childhood TV series, Grizzly Adams, where the guy lives up in the mountains with a bear he saved from a circus and a Native American friend visits him from time to time. In some ways, he has become the epitome of a person with high nature intelligence for me. He managed to blend in with his environment and became one with nature. He lived in a house he built from materials the forest offered. He lived in nature and did not possess it. He also understood and surrendered to the cycles of life and embraced the different weather of every season of the year. There was no judgement of nature and its elements. He spent the entire days outdoors, observing and enjoying plants and animals. Nature was his home, and he did not fear it. He would help some animals here and there, just like Tarzan did (yet another one with high nature intelligence), and did this without the omnipotent feeling of anthropomorphism we've developed. The nature is there for him to reflect on his life. And he reflected humility, admiration, and respect. But he was a simple man of the 19th century. To describe a modern person with high nature intelligence, we need to understand that we no longer live in nature, but in towns and cities. Our lives no longer entirely depend on survival in nature. Nevertheless, the modern person with high nature intelligence still respects old traditions, yet adds some new (modern) solutions. This person re-learnt to reuse and not just consume the nature's resources. This person also learnt to track their carbon footprint as the lives we live nowadays take a toll on nature.

Appendix B: Outcomes of factor analyses and reliabilities

COGNITION
Rotated Component Matrix

	Curiosity	Skills	Literacy
C6: I am interested in lessons or television shows, videos, books or objects about nature	,86		
C8:I am intrigued by how everything in nature seems to be connected	,86		
C7: I enjoy the beauty and experienc-es related to nature	,74		
C14: When in nature, I usually have a pretty good idea of where north, south, east and west are		,84	
C15: I know how to orient myself in nature		,76	
C11: I possess skills to survive a few days in a nature area on my own: e.g. make a fire; find food; build a shelter for sleeping; find a path; read animal tracks; know which direction to go		,71	
C1: I am able to identify or classify living and non-living things that exist in nature			,79
C2: I can recognize and understand processes, patterns and cycles in nature			,65
C3: I create, keep or have my own collections, journals, natural objects, images, photographs and specimens			,64
VARIANCE EXPLAINED	32%	20%	12%
Scale reliability (cronbach's alpha)	.79	.69	.54

RELIABILITY TOTAL COGNITION SCALE (9 ITEMS): .72

EMOTION
Rotated Component Matrix

	Embodiment	Connectedness	Open-mindedness
E14: It does not bother me when I get wet or dirty during a visit to nature	,80		
E11: I like to walk barefoot in the grass	,80		
E12: I enjoy digging the earth with my bare hands	,77		
E3: I think of the natural world as a community to which I belong		,81	
E7: I care deeply for all living beings: humans, animals, plants		,80	
E4: I feel a kinship with animals and plants		,69	
E13:Dead birds and other small animals in nature attract my attention without making me feel scared			,80
E15: Spending a day in nature without toilets or other amenities would make me feel uncomfortable	,51		,69
E9: I would rather not kill flies or other insects			,68
VARIANCE EXPLAINED	43%	15%	12%
Scale reliability (cronbach's alpha)	.80	.80	.62

RELIABILITY TOTAL EMOTION SCALE (9 ITEMS): .82

SPIRIT
Rotated Component Matrix

	Authenticity	Transcendence	Presence
S12: Nature inspires me to live true to myself and my values and beliefs	,80		
S13: When I am in nature I feel less pressured by others to behave in certain ways	,79		
S1: Nature inspires me to reflect on the meaning of life	,78		
S2: Even ordinary natural settings are full of miraculous things		,75	
S5: I find it easy to to connect to nature in a more spiritual way		,72	
S3: I feel that all inhabitants of earth, human, and nonhuman, share a common 'life force'		,71	
S6: Being in nature helps me to focus on the present			,84
S8: It feels like I forget the time when I am in nature			,74
S7: When I am in nature I am aware of sensations caused by my surroundings (e.g., smells, sounds, the wind on my face)		,56	,58
VARIANCE EXPLAINED	47%	13%	9%
Scale reliability (cronbach's alpha)	.83	.67	.74

RELIABILITY TOTAL SPIRITUALITY SCALE (9 ITEMS): .85

ACTION
Rotated Component Matrix

	Health	Socializing	Engagement
A3: After a visit to nature I feel refreshed and energized	,87		
A1: When I feel stressed or down, to be in contact with nature makes me feel better	,80		
A2: Nature helps me to sort out my thoughts and feelings	,80		
A14: Being surrounded by nature makes it easier to mingle and connect with other people		,87	
A11: It is important to me to share nature experiences with others		,80	
A13: Natural settings are a perfect place to meet with friends		,72	
A10: I am concerned about the climate and the environment			,88
A6: I pay attention to my consumption habits out of respect for nature and the environment			,65
A7: Protecting nature and the environment is a guiding principle in my life			,65
VARIANCE EXPLAINED	50%	13%	11%
Scale reliability (cronbach's alpha)	.85	.81	.69

RELIABILITY TOTAL ACTION SCALE (9 ITEMS): .86

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Co-funded by the
Erasmus+ Programme
of the European Union

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