



## The impact of blue space on human health and well-being – Salutogenetic health effects of inland surface waters: A review

Sebastian Völker\*, Thomas Kistemann

*Institute for Hygiene and Public Health, University of Bonn, Sigmund-Freud-Str. 25, 53105 Bonn, Germany*

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### ABSTRACT

Water is one of the most important physical, aesthetic landscape elements and possesses importance e.g. in environmental psychology, landscape design, and tourism research, but the relationship between water and health in current literature is only investigated in the field of environmental toxicology and microbiology, not explicitly in the research field of blue space and human well-being. Due to the lack of a systematic review of blue space and well-being in the various fields of research, the aim of this review is to provide a systematic, qualitative meta-analysis of existing studies that are relevant to this issue.

Benefits for health and well-being clearly related to blue space can be identified with regard to perception and preference, landscape design, emotions, and restoration and recreation. Additionally, direct health benefits have already been stated. The studies included in the review are mostly experimental studies or cross-sectional surveys, focusing on students as the subject group.

There is a need for more qualitative and multi-faceted, interdisciplinary studies, using triangulation as a method to achieve a resilient image of reality. A broader study design considering all age groups would contribute to identifying benefits for the whole of society. The inattentiveness to blue space makes it difficult to measure long-term effects of blue space on well-being. There is still little respect for water and health in planning issues, although salutogenetic health benefits can be identified. To close the gap regarding missing systematic concepts, a concept for assessing salutogenetic health effects in blue space is provided. Blue space is considered therein as a multi-dimensional term including four dimensions of appropriation, as well as at least five ontological dimensions of substantiality. The aim of the concept is to support researchers and practitioners analysing health effects in blue space.

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### Introduction

The basis for any corporate development is the existence of water. Water is also considered to be one of the most important aesthetic landscape elements (Kaplan and Kaplan, 1989). An attractive landscape provides health and well-being to humans (Abraham et al., 2010). Green space is a common term for natural areas, but if there is a further division of green space, one can recognise that many areas are in fact blue (Gledhill and James, 2008). The critique, that water as an aspect of landscape is not thoroughly recognised in research, has already been stated in landscape ecology. In this field Lianyong and Eagles (2009) criticise the inattentiveness of academics towards 'waterscapes' and show a clear relationship between waterscapes and environmental health. The term 'blue space' summarises all visible surface waters in space as an analogy to green space, not as a sub-category. Except in landscape ecol-

ogy this critique has not been formulated explicitly in research, despite the recent trend in practice in urban planning to consider water as an important element of landscape. This is expressed in the embodiment of settlement areas in which great importance is attached to water (Fagnoni, 2009; Syme and Nancarrow, 1992). Cities located by rivers or at lakes have a distinctive and unique physiognomy which creates their own, special character (Strauss, 2002). Since the 1980s there has been a clear trend in (urban) planning for waterfront revitalisation, towards water and sites containing water, providing access to blue space partly with expensive planning (BAFU and Schweizer Wanderwege, 2009; Desfor and Jørgensen, 2004; Harvey, 1991; Sandercock and Dovey, 2002; Wood and Handley, 1999; Wüthrich et al., 2003).

### Health and well-being

In defining health, it has to be considered, that the term is a discursive construction of society and policy makers (Bunton, 1997). Thus the definition can vary over time. In this review the health definitions of the World Health Organisation (WHO) are generally used. Primarily, the WHO defined health in 1948 as "a state

\* Corresponding author. Tel.: +49 228 287 16862; fax: +49 228 287 19516.

E-mail addresses: [Sebastian.Voelker@ukb.uni-bonn.de](mailto:Sebastian.Voelker@ukb.uni-bonn.de) (S. Völker), [Thomas.Kistemann@ukb.uni-bonn.de](mailto:Thomas.Kistemann@ukb.uni-bonn.de) (T. Kistemann).

of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO, 1948). The influence of water on health was addressed at an international health care conference in 1978 in Alma Ata (WHO, 1978). Eight years later the Ottawa-Charter for Health Promotion declared health as “a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities” (WHO, 1986). The Charter was developed under the influence of Antonovsky’s concept of salutogenesis (1979), which, contrary to pathogenetics, takes account of the reasons and circumstances for the creation and preservation of health. The salutogenetic concept as the basis for health promotion considers individual and corporate resources for health, well-being and quality of life as central requirements to prevent health risks and potential illnesses (Antonovsky, 1998). The European Charter on Environment & Health (WHO, 1989) and the United Nations Conference for Environment and Development (UNCED) in Rio de Janeiro in 1992 also supported salutogenetic health promotion.

Well-being is a complex measurable subjective state of consciousness (Trojan and Legewie, 2001), which contains components like the habitual, actual, individual and social well-being (Becker, 1991; Keyes, 1998; Luginbühl, 2006). According to this, health is a multidimensional, dynamic construct, which contains a “process-related, biological, psychological and social interaction of physical, psychological and socio-cultural, ecological and other components” (Abraham et al., 2007) and contributes to a health effect and a subjective sense of well-being.

#### *Landscape and health – the concept of therapeutic landscapes*

The influence of landscape on health has already been stated extensively (Frumkin, 2001; Maller et al., 2006). Gesler’s (1992) concept of therapeutic landscapes and the consecutive development of this concept helped to systematically investigate the links between health and landscape. It has been recognised as a mixture of both non-pathogenetic health concepts and health geography’s perception of the cultural turn (Kearns and Joseph, 1993). Gesler defined different aspects of a therapeutic landscape including the physical environment, the social environment and the spiritual environment. His case studies mainly investigated places clearly dedicated to healing, like Epidaurus in Greece, Lourdes in France or Bath in Great-Britain and recognised mainly the physical and spiritual environment on a naturalistic or humanistic level (Gesler, 1993, 1996, 1998). In the late 1990s, the focus on traditional healing landscapes was recognised to be just one aspect of therapeutic landscapes (Williams, 2007). Subsequent studies broadened the use of the concept and also addressed non-traditional healing landscapes, such as home environments (Williams, 2002) or summer camps for children (Thurber and Malinowski, 1999; Kearns and Collins, 2000). To date the therapeutic landscape model focuses on health promotion and the role of everyday landscapes as landscapes of health.

#### *Blue space and well-being*

In the past many studies were carried out observing the relationship between green space in landscape and human well-being, containing water as an element of green space (see e.g. Han, 2003; Laumann et al., 2001; Ulrich et al., 1991). In the current literature of water and health the relationship is exclusively discussed in the fields of environmental ecology, toxicology and microbiology (Brede et al., 2010; Gledhill and James, 2008; Ramos and Aguilo, 1988; Völker et al., 2010), but not explicitly in the research field of blue space and human well-being. Considering landscapes in environmental psychology, it remains unclear, whether the presence of water, vegetation or other reasons cause positive reactions

**Table 1**

Numbers of articles found in each of the three search engines used for keyword and phrase searches.

Keyword/phrase	ScienceDirect	PubMed	Web of science
Water	412,885	401,721	>100,000
Water + health	78,668	15,524	3357
Water + well-being	309,643	312	14,121
Water + preference	21,667	2783	361
River	36,768	22,724	56,692
River + health	9008	1701	1401
River + well-being	29,800	18	4818
River + benefit	4318	148	331

(Dramstad et al., 2006). Due to a lack of research focussing on blue space, this gap cannot yet be closed. To date there has been no systematic review of well-being and blue space in the various research fields dealing with this theme. The variety of results is on the one hand an advantage, because it provides a broad, interdisciplinary view of blue space, but it also leads to the major challenges of the current review: the lack of consistent definitions, systematic concepts and standardised methods. Amongst others, a systematic review provides a concept for researchers to analyse blue space and health, and a solution which methods are useful for this theme. Town developers will find an approach to deal with water and health in urban environments encouraging them to be more aware of this issue.

The evolving questions are consequently: How can blue space promote well-being? What are the major beneficial aspects of blue space for human well-being? How are blue spaces perceived and evaluated? What role does blue space play for restoration and recreation? How are blue spaces considered in spatial planning issues?

#### **Methods**

The approach of this study is a systematic, qualitative meta-analysis of existing studies that are relevant to blue space and well-being. To provide an interdisciplinary meta-analysis the critical realist approach is used to integrate quantitative and qualitative studies. The approach states that a mechanism cannot be disproved by the identification of a missing recognition (Sayer, 2001).

The procedure to identify relevant articles for the review is presented in Fig. 1. We searched for English-, German-, or French-language studies. First, electronic databases (PubMed, Web of Science and ScienceDirect), single key journals in areas that related to the topic, the reference list of earlier studies, topic-related expert networks and relevant organisations were evaluated and provided the majority of relevant articles. Keyword and phrase searches were undertaken within titles (Web of Science), titles and abstracts (PubMed), and titles, abstracts and keywords (ScienceDirect) to identify articles related to health benefits and well-being on the basis of the concept of therapeutic landscapes. The following terms were used: recreation, local, leisure, health, well-being, human, therapeutic landscape, preference, affect, restorative, symbolic, health promotion, social, aesthetics, benefit, perception, spirituality and healing. The search was then refined using terms related to water: water, river, lake, aquatic environments, riparian, well, stream, spring, and canal (see Table 1).

In a second step, after consideration of the primarily selected studies, inclusion and exclusion criteria were defined. Those articles covering the pathogenetic impact of water on human health, such as studies concerning microbial contaminants, as well as the agricultural use of food, material well-being and marine environments were excluded. Only studies from industrialised countries were included to provide maximum comparability and reliability. Relevant original studies and literature reviews

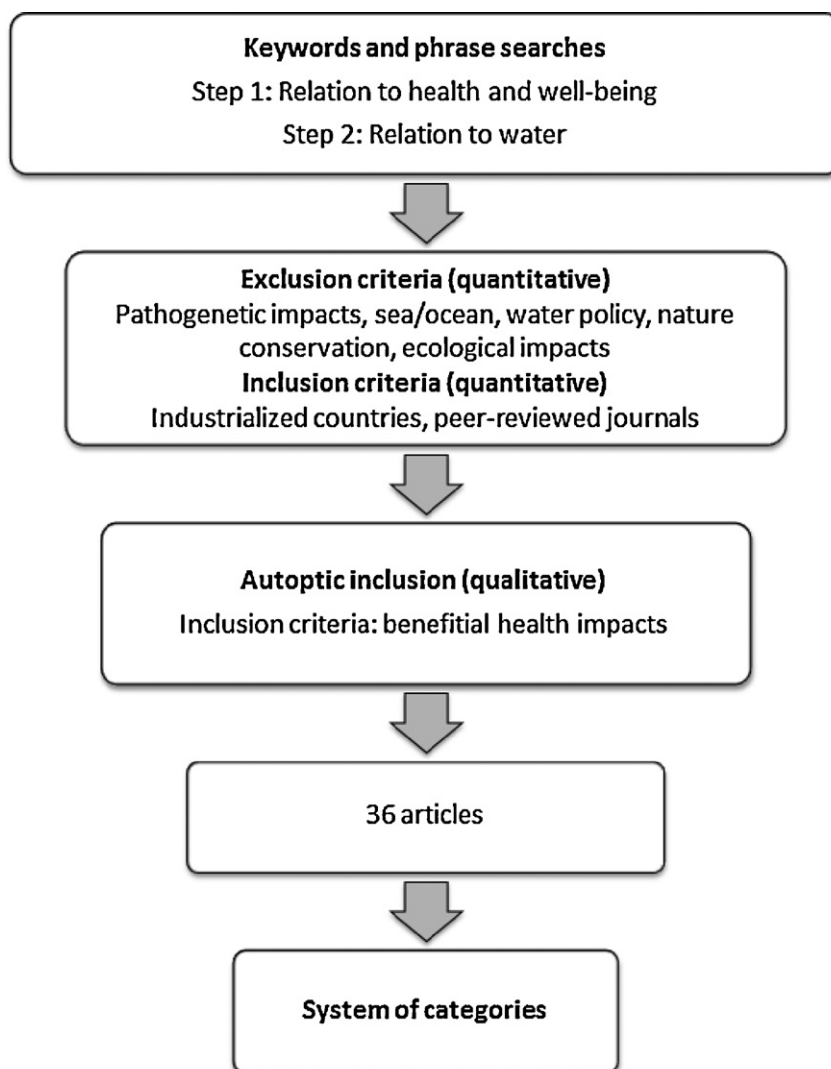


Fig. 1. Five-step procedure to identify relevant articles for the review.

from peer-reviewed journals were chosen. Studies dealing with water policy, nature conservation and ecological impacts were excluded. Because of the obvious presence of unrequested and non-homogeneous results provided by the search engines, an autoptic analysis of the remaining articles was conducted to include only those articles dealing with beneficial health impacts on the basis of the aforementioned definition of health and well-being and the concept of therapeutic landscapes. Following this qualitative step a total of 36 articles in the time range from 1981 to 2011 met the inclusion criteria for the review.

All articles were entered into a matrix and were classified in relation to apparent content, location of the study, experiment design and methods, underlying concept, results and the positive impact of water. Information about authors, publication year, journal and branch of study were also added.

To extract, classify, and synthesise the findings reported in this review, we developed a categorical system using five categories out of the reviewed literature to describe attributes for human well-being and health benefits: perception and preference, landscape design, emotional benefits (e.g. philosophical and spiritual perspectives), restorational and recreational benefits, and direct health benefits. These categories evolved after reviewing the literature, where several studies identified surface water as an important

basis for the perception and preference of landscapes (Hagerhall et al., 2004; Jackson, 2003; Kaplan, 1985; Ulrich, 1983), and, additionally, as an important aspect of philosophical, spiritual and environmental meaning, as well as having the potential for recreation, restoration and healing (Knopf, 1991; Spash, 2000). Within these categories the review aims to identify the health-promoting impacts and benefits of blue space in industrialised countries for human well-being. To synthesise and interpret these, the data was charted by sorting the findings according to the system of categories (Arksey and O'Malley, 2005). The results were arranged in a descriptive-analytical way. An overview of the studies reviewed is presented in Table 2. Finally, a two-dimensional matrix for further investigations of this research field is suggested.

## Results

### Perception and preference

Perception is expressed by using one's senses to produce feelings and attitudes towards blue space. Generally, water represents a vital natural resource and a consumption good for human beings (Michel-Guillou, in press, p. 14), but the visitor of blue space has various cognitions and perceptions. "Concerning psychological effects

**Table 2**  
Findings from the literature review: categories of study design and the reported impact of blue space in the system of categories.

No.	Authors	Study design	Methods	Reported impact of blue space in the system of categories				
				Perception and preference	Landscape design	Emotional benefits	Restoration and recreational benefits	Direct health benefits
1	Asakawa et al. (2004)	Survey (cross-sect.)	25 rating items on five-point Likert scale, analysis of variation (ANOVA), Euclid distance matrix, Ward's method of cluster analysis	X	X		X	
2	Burmil et al. (1999)	Review	Literature review	X	X	X	X	X
3	Coeterier (1996)	Review	Literature review	X	X		X	
4	Dramstad et al. (2006)	Experimental study	Photographs rated on five-point Likert scale	X				
5	Felsten (2009)	Experimental study	Environmental stimuli rated on seven-point Likert scale measuring ART (Attention Restoration Theory)			X		
6	Foley (2011)	Qualitative study	Ethnographic, visual and performative methods		X	X		X
7	Fredrickson and Anderson (1999)	Qualitative study	On-site observations, personal field journals, in-depth interviews		X	X		
8	Gelso and Peterson (2005)	Survey (cross-sect.)	Questionnaire including importance of environmental issues rated on five-point Likert scale				X	
9	Gesler (1996)	Qualitative study	Literature study, participant observation	X		X		X
10	Herzog (1985)	Experimental study	Natural environments rated on five-point Likert scale	X	X	X		
11	Herzog and Barnes (1999)	Experimental study	Different settings rated on five-point Likert scale	X			X	
12	Herzog and Bosley (1992)	Experimental study	Natural settings rated on five-point Likert scale	X		X		
13	Herzog et al. (2000)	Experimental study	Natural environments rated on five-point Likert scale	X				
14	Kaltenborn and Bjerke (2002)	Experimental study	Colour photographs rated on seven-point Likert scale with 25 items	X				
15	Karmanov and Hamel (2008)	Experimental study	Videos rated on five-point Likert scale with 30 items	X	X		X	X
16	Korpela et al. (2010)	Survey (cross-sect.)	Postal questionnaires on restorative experiences				X	
17	Laumann et al. (2001)	Experimental study	Video rated on seven-point Likert scale	X		X		
18	Luttik (2000)	Survey (cross-sect.)	HPM = Hedonic Pricing Method, environmental information drawn from maps, detailed information by visiting each house	X				
19	Michel-Guillou (in press)	Survey (cross-sect.)	Postal or electronically sent semi-directive questionnaires	X				
20	Nasar and Li (2004)	Experimental study	Model scenes rated on eight bi-polar scales	X			X	
21	Ogunseitan (2005)	Survey (cross-sect.)	18-item questionnaire on topophilia and 26-item World Health Organisation Quality of Life (WHOQOL) instrument				X	X
22	Pflüger et al. (2010)	Experimental study	Online photographic survey	X				

23	Regan and Horn (2005)	Survey (cross-sect.)	Thematic analysis of free-response questionnaires			X		
24	Ryan (1998)	Survey (cross-sect.)	Photos of river corridor scenes rated on five-point Likert scale questionnaires	X				X
25	Smardon (1988)	Review	Literature review					X
26	Smith et al. (1995a)	Survey (cross-sect.)	Interviews with questionnaire and laboratory measurements	X				
27	Smith et al. (1995b)	Survey (cross-sect.)	Interviews with questionnaire and laboratory measurements	X				X
28	Steinwender et al. (2008)	Survey (cross-sect.)	Objective, water-related parameters, short interviews at study sites, field examination of waters	X	X			
29	Ulrich (1981)	Experimental study	Psychophysiological effects of colour slides evaluated with alpha amplitude, heart rate, emotional states, and five-point scales with 36 items	X		X		
30	Van den Berg et al. (2003)	Experimental study	Depression, anger, tension, profiles of mood state scale (POMS) measured on ten-point Likert scale, total happiness and stress on 100-point scale, d2 Mental Concentration Test	X				
31	Velarde et al. (2007)	Review	Literature review					X
32	Whalley (1988)	Review	Literature review		X	X		
33	White et al. (2010)	Experimental study	Photos rated on 4- and 6-step questionnaires including willingness to pay, Perceived Restorativeness Scale and ANOVA	X		X		X
34	Williams (2010)	Qualitative study	Participant observation, review of bi-monthly publications, key-informant interviews			X		X
35	Yabes et al. (1997)	Survey (cross-sect.)	Interception survey of canal users and telephone questionnaires	X		X		X
36	Yamashita (2002)	Survey (cross-sect.)	Photo-Projective Method	X	X			X



of the three environments [water, nature, urban] [...], exposures to the two nature categories – especially water – had more beneficial influences” (Ulrich, 1981, p. 548) and water plays an important role in the perception of nature (Herzog et al., 2000, p. 341). According to this, a wider body of water and the presence of bank vegetation strongly effects positive perceptions (Steinwender et al., 2008, p. 125). Views of water are rated as positive, attractive, and fascinating (Burmil et al., 1999, p. 104; Karmanov and Hamel, 2008, p. 122; Laumann et al., 2001, p. 132; Ryan, 1998, p. 229; White et al., 2010, p. 487). In approaching blue space, people recognise a higher level of humidity, different wildlife and high diversity as a result of the close relationship between water and land (Burmil et al., 1999, p. 103), also known as the waterscape (Herzog, 1985, p. 225). Important aspects of the sensual perception of blue space are the sound of water, its colour, clarity, motion, and context.

People admire the sounds of water and great importance is attached to the variety and special nature of these sounds, ranging from calm, laminar flows to energetic, roaring sounds (Burmil et al., 1999, p. 103; White et al., 2010, p. 490). White et al. (2010, p. 490) consider the calm sounds of water to be restorative. Sounds are clearly correlated with the view of water, its changing colours and variable movement. Blue water is generally preferred to yellow water (Smith et al., 1995b, p. 40). Smith et al. (1995b, p. 32) investigated the yellow water of the Inangahua River, which appeared visually clear but yellow-coloured, because of the high amount of yellow-substances. Blue water is associated with coolness, white water with power and roaring sounds (Burmil et al., 1999, p. 103), yellow waters are accepted when they are perceived as natural (Smith et al., 1995b, p. 42). Colour and clarity are significant determinants of public perception of river water quality (Herzog, 1985, p. 240; Pflüger et al., 2010, p. 76), which is crucial for water-based activities like bathing (Smith et al., 1995b, p. 42).

The context of blue space is also an important measure for human perception. Water connected with naturalness increases its visual rating (Smith et al., 1995a, p. 50). Nature and scenery are rated as the main perceptive factors (Asakawa et al., 2004, p. 180). The occurrence of, for example, gently curving banks, calm aquatic scenes, high diversity or an admirable human urban design enhance the aesthetic values of blue spaces (Burmil et al., 1999, p. 104; Karmanov and Hamel, 2008, pp. 122–123; White et al., 2010, p. 490; Yabes et al., 1997, p. 182; Yamashita, 2002, pp. 9–10).

Yamashita (2002, p. 9) was able to identify distinct perception attributes of rivers. He used the Photo-Projective Method and handed out video cameras, still cameras and microphones to record feelings and perception attributes about pictures taken of rivers in Japan by adults and children. The findings indicate different key expressions for water, riverside micro topography, scenery, and ephemeral factors. For water, Yamashita gives a mixture of descriptive and feeling expressions, for riverside micro topography only descriptive expressions and for scenery and ephemeral factors only expressions describing feelings were used. Key feeling expressions for water were “pure” and “cold” (Yamashita, 2002, p. 9), which induce a sense of cleanliness and freshness (Herzog, 1985, p. 240). “The perception of cleanliness and refreshment associated with water leads to a sense of regained energy, youth, and health” (Burmil et al., 1999, p. 101). The scenery is considered to be “peaceful”, “traditional”, “worth-preserving” and “preferable” (Yamashita, 2002, p. 9). Perception factors are correlated with preference. If blue space is considered to be positive and worth visiting, the site will be preferred for recreational use and social participation (Asakawa et al., 2004, p. 180).

The presence of water is a strong predictor of preference for landscapes in general (e.g. Herzog and Barnes, 1999, pp. 171–172; Nasar and Li, 2004, p. 236). This is the case even if the water is not directly visible, but due to the presence of longitudinal vegetation

the presence of a river can be imagined (Dramstad et al., 2006, p. 471). The factors of preference for blue space are highly correlated with perception. “[T]he two factors of recreational use and nature and scenery were found to be highly related to [...] preference [...]” (Asakawa et al., 2004, p. 180) as well as sensory factors (Coeterier, 1996, p. 38; Nasar and Li, 2004, p. 236; Steinwender et al., 2008, p. 125).

Residents near water would miss the nearby blue space if they moved (Ryan, 1998, p. 233). Yabes et al. (1997, p. 182) found in their study that 66% of all passengers on a canal would choose a house or apartment near the canal if they move. Local and newer residents with their home close to a river rate blue space as highly valuable (Asakawa et al., 2004, p. 177; Ryan, 1998, p. 235). This is reflected by a study conducted by Luttik (2000), who analysed transaction prices for 3000 houses in eight towns in the Netherlands and compared them to environmental information drawn from maps and from detailed information by visiting each house. The results showed the most influential environmental attribute in the study was the presence of water features. In the city of Emmen water views resulted in house prices 10% higher than the average. For gardens bordering on water, prices were 11% higher. In the city of Leiden, an attractive landscape with water features increased house prices by 7%, water views by 8% (Luttik, 2000, pp. 165–166).

People build categories of landscapes with and without water and rate them significantly differently (Burmil et al., 1999, p. 104). For perceptive reasons, landscapes with blue space are highly desired by humans. This includes wide stretches of water, waterscapes that provide an extensive view, natural scenes and urban scenes containing water, rushing water, waters with normalised flows, large water bodies, wild scenery containing water, river scenes, mountain waterscapes including rushing water and lakes, and canals (Asakawa et al., 2004; Dramstad et al., 2006; Herzog, 1985; Herzog and Bosley, 1992; Herzog et al., 2000; Kaltenborn and Bjerke, 2002; Luttik, 2000; Pflüger et al., 2010; Ryan, 1998; Steinwender et al., 2008; White et al., 2010). The wide variety shows the extremely high level of attraction of blue space for human beings.

### *Landscape design*

As a primary landscape element, water has been and is still today an important part of landscape design. Asakawa et al. (2004, p. 177) recognised that “[i]n order to achieve highly preferred scenery in these stream corridors, there are three necessary components of natural scenery: water, vegetation, and sequential experience with variety.” Due to strong positive responses to water, its positive or valuable overall quality and because it is critical for ecosystems, blue space is essential in design issues (Steinwender et al., 2008, pp. 124–125).

Blue space contributes to naturalness and spaciousness, but riparian villages and their formation are dependent on water control (Coeterier, 1996, p. 33). For healthy urban environments, Karmanov and Hamel (2008, p. 123) mention the need for water in design. They integrate aesthetic, cultural and ecological characteristics in their definition.

The design of waterscapes is, along with other reasons, mainly for the viewing enjoyment of humans. Therefore designers have to create a meaning, like legibility and coherence and give a sense of involvement through complexity and mystery (Coeterier, 1996, pp. 38–40). Meaningful biophysical attributes exist, such as water, vegetation, geological formations and wildlife, which make the user recognise blue space as a place where he has a feeling of belonging and attachment (Fredrickson and Anderson, 1999, p. 28; Yamashita, 2002, p. 13). Within these landscapes, water can be the major element giving meaning and defines individual places. It transmits structure and creates space and mystery. The landscape becomes

more readable and mysterious, which contributes significantly to a unique sense of place (Burmil et al., 1999, p. 103; Herzog, 1985, pp. 238–239). A sense of place in waterscapes is connected with emotions and “a symbolism difficult to achieve with any other natural element” (Whalley, 1988, p. 145). For example, garden designers want to generate inspiration, exuberance and vigour by providing waterscapes, enhance human satisfaction by the use of the glitter of water and create a sense of brilliance and cheerfulness by the construction of small pools (Burmil et al., 1999, p. 103; Whalley, 1988, p. 148).

#### *Emotional benefits*

A strong sense of place can influence well-being, as well as other emotional feelings towards blue space. Water is recognised as a natural mirror, creating mystery by providing a picture that is not as clear as a normal mirror (Burmil et al., 1999, p. 101; Nasar and Li, 2004, p. 236). Water covers body requirements and is therefore a symbol of purity, expressed in human mental and spiritual life. “The concept of water as a ‘sacred substance’ is ubiquitous in religious history” (Strang, 2004, p. 85), in Christianity and Islam in particular (Burmil et al., 1999, p. 102; Gesler, 1996, p. 100). Water forms part of essential rituals involving birth, marriage or death. Religions also use the symbol of water to provide a place for healing as in Lourdes in France. A pilgrim clearly expressed his emotions on coming to Lourdes: “At the grotto, everything speaks of water: the rushing Gave River, the drizzling rain from the cloudy sky, the spring of Masabielle (. . .) I want to be purified. I want to be cleansed” (Nouwen, 1990, p. 8, cited by Gesler, 1996, p. 100). Williams (2010) also recognises the symbols of water at St. Anne de Beaupre in Quebec, Canada, a place dedicated to healing. In this place, people attach water with miraculous powers, fertility and the generation of life (Williams, 2010, p. 1637). Foley (2011, p. 477) identified in his study about holy wells the emotional need for places of healing connected with water, which is expressed in the notes, requests and votive offerings left behind at the wells.

In a qualitative study conducted by Fredrickson and Anderson (1999) to identify aspects of spiritual inspiration in the wilderness, a trip participant on an outdoor recreation trip by canoe on a river expresses his source of inspiration: “Yeah, I want to go somewhere where there’s trees and water. [. . .] I want to connect with myself, and once I do that, then I am connected with something larger than myself. For me to experience ‘that which is spiritual’, it has to be nature, with water, with trees” (Boundary Waters trip participant, Fredrickson and Anderson, 1999, p. 34).

Another participant describes his feelings of being on the trip: “I remember crawling out of my tent and creeping down to the water’s edge and watching pale moonlight dance across the surface of the water. And there across the lake was a beaver, slapping its tail against the water. [. . .] I mean, I felt such a sense of peace hearing that sound. And I thought to myself, what a simple lifestyle this is, being attuned to the sights and sounds of nature” (Boundary Waters trip participant, Fredrickson and Anderson, 1999, p. 31). This mental immersion in waterscapes is hypothesised and explained using several aspects such as tranquillity, attention, interest, fascination or compatibility (Herzog and Bosley, 1992, p. 123; Laumann et al., 2001, p. 132; Ulrich, 1981, pp. 549–551; White et al., 2010, p. 490). In particular, water has more positive influences on emotional states compared to other environments (Felsten, 2009, p. 166; Ulrich, 1981, p. 548).

People not only use blue space individually, but also to meet or to be together with other people and enjoy social activities (Fredrickson and Anderson, 1999, p. 28; Yabes et al., 1997, p. 183). Regan and Horn (2005, p. 65) found out that water is preferred by people in a relaxed or happy mood-state followed by a stressed

mood-state, which implies that people use blue space for both restoration and for recreational activities.

#### *Restoration and recreational benefits*

From a restorative perspective (Kaplan, 1985), blue spaces in urban and natural contexts have stress-reducing, mood-enhancing powers, expanding mental attention and mood (Karmanov and Hamel, 2008, pp. 122–123). Reflections and diversity are also known to have restorative effects (Nasar and Li, 2004, p. 237; Ogunseitan, 2005, p. 147). Restorative experiences are highly correlated with blue space (Gelso and Peterson, 2005, p. 43; Herzog and Barnes, 1999, p. 180; Korpela et al., 2010, p. 204). Water control provides the basis for recreational activities (Coeterier, 1996, p. 33). To conduct and experience restorative activities, riverfront land should provide the possibility to access water, aided by linear footpaths to encourage movement (Asakawa et al., 2004, p. 180; Yabes et al., 1997, p. 182). Recreation activities can be aided by benches for small respites, as well as personal safety for e.g. bathing activities (Asakawa et al., 2004, p. 177; Burmil et al., 1999, p. 104; Smith et al., 1995b, pp. 42–43).

The experiences can be classified into four categories: kinetic recreational experiences, situation-based recreational experiences, harvest experiences and substitution or aesthetic experiences (Smardon, 1988, pp. 132–134). Kinetic recreational experiences include those with a higher degree of motion on water, like boating, sailing or canoeing (Yamashita, 2002, p. 9) and at the water’s edge like cycling or jogging (Yabes et al., 1997, p. 182; Yamashita, 2002, p. 9). Situation-based recreational experiences refer to one location at the water, which is visited several times for experiences such as swimming, playing in the water, social interactions or walking (Smith et al., 1995b, pp. 33–35; Yabes et al., 1997, pp. 182–183; Yamashita, 2002, p. 9). Harvest experiences include fishing (Yamashita, 2002, p. 9). Contemplative or aesthetic experiences focus on the passive exploration of blue space and cover perception of views or sounds (Smith et al., 1995b, p. 40; White et al., 2010, p. 490). These benefits are rather experienced or reputed than scientifically measurable, but the positive health effects of these physical activities are well known for the prevention of cardiovascular illnesses, obesity and cancer (Bell et al., 2008; Carr et al., 2009; Friedenreich and Orenstein, 2002; Kodama et al., 2006; Matsuda, 2006) as well as anxiety and depression (Lloret, 2010).

#### *Direct health benefits*

The direct health benefits of blue space have mainly been recognised by researchers within the concept of therapeutic landscapes. In the therapeutic landscapes concept, water forms an important part of landscape (Williams, 2010, p. 1637). Foley describes holy wells in Ireland as “a piece of micro-landscape of healing and wellness” and as “sites of indigenous health” (Foley, 2011, p. 477). Visitors bathe their children in the well as a symbol of health promotion in early life. The therapeutic landscape of Lourdes with its spring is described as a centre for healing, where water is a part of cures and is dedicated to healing (Gesler, 1996, p. 101). Springs are known as sacred healing places (Burmil et al., 1999, p. 101). In other research areas, a relationship between water and well-being and health has been stated (Velarde et al., 2007, p. 208), e.g. the appreciation of water bodies has been correlated with a high quality of life (Ogunseitan, 2005, pp. 146–147) and views of water are potentially beneficial for health (Burmil et al., 1999, p. 104).

## **Discussion**

Blue space plays an important role in landscape perception, preference and design as a part of the natural landscape. More and

more researchers, mainly environmental psychologists, recognise that blue spaces themselves are important in people's evaluation of landscapes (White et al., 2010). Though Van den Berg et al. (2003) found that water has no influence on restoration, they did not consider that their subjects were exposed to an extraordinary degree of stress by viewing a "faces of death" video. This study thus cannot disprove the health effects of blue space in everyday life. The number of studies clearly focussing explicitly on water is still limited. But this can be considered rather a challenge for environmental health research than a limitation of this review.

Lots of experimental studies, applying only an abstract image of reality, have been carried out in recent years (see Table 2). Although researchers have already stated similar findings when looking at real nature (Martens and Bauer, 2010), additional results may still be expected (Abraham et al., 2007), due to the high variance of diversity and individual perceptions and preferences. The importance of diversity is expressed, for example, by White et al. (2010), who found that the most preferred views contained two-thirds of water; those with less than one-third of water or scenes containing only water were rated less positively, which shows the importance of diversity, edges and borderlines as well as the need for a context of water together with surrounding land. Experimental studies mainly contain photos or videos showing a special focus on the environment, so the individual perspective more or less disappears. In this regard, a visitor perceiving authentic blue space experiences water in its whole colour-range in a 3-D view with its smell, taste and sound, whereas pictures provide a 2-D view with mostly only one colour, i.e. blue. For example, Nasar and Li (2004) presented a model to measure the perception of material within a box in front of a photo of a park. They compared water to an artificial mirror and sand. As sand is not a common part of the everyday landscape in parks, the bias seems to be too high for the argument that water is preferred due to its reflective characteristics.

It is a major challenge to cover the diverse individual perspectives of experiencing blue space. Findings indicate that perceptions of the aesthetic quality of water were strongly influenced by subjective factors like mood, meteorological factors, choices of activities, environmental value orientations, age group, and expertise in water issues (Gelso and Peterson, 2005; Herzog et al., 2000; Kaltenborn and Bjerke, 2002; Pflüger et al., 2010; Regan and Horn, 2005; Smith et al., 1995a; Steinwender et al., 2008). Thus there is a need for more qualitative, multi-faceted, interdisciplinary studies, using triangulation as a method to achieve a resilient image of reality, like Strang's (2004) ethnography of water dealing with water policy. In this respect the question of the visitors' emotional and experiential differences emerges being either at artificial or at real waterscapes. Whilst many studies have focused on students so far, broader study designs considering different age groups and gender are needed to identify the benefits for society. Current inattentiveness to blue space makes measuring the long-term effects of blue space on well-being difficult. There is therefore obviously a need for longitudinal surveys as well.

#### *Blue space in the urban environment*

Regan and Horn (2005) found out that water is preferred by people in a relaxed or happy mood, followed by those who are stressed. This indicates that water is a favourite place to spend leisure time and for recreational activities in addition to its restorative effects from everyday stress. People spend most of their leisure time around their homes (Frumkin, 2003), and in industrialised countries most of the population live in cities (Rees and Wackernagel, 1996). However, the potentials of blue space in urban environments has been underestimated, because with the exception of a few studies, only natural environments (partly with water) have been compared to urban environments (without water) (Laumann et al.,

2001; Ulrich et al., 1991). So in fact, the potentials of blue space for health mainly in natural and rarely in urban environments could be presented in this review.

There is little evidence of water perception and preferences in urban environments. The use of urban settings as the most challenging scenario compared to natural environments by environmental psychologists is a predictor for some parts of cities, but does not fit with the different characteristics of urban settings in reality. In studies that also consider urban characteristics like design, the differences of natural and urban environments are marginalised. Luttik (2000) proved the high value of water using house prices. The relationship between proximity to water and property values was initially investigated in the 1970s (Darling, 1973; Brown and Pollakowski, 1977). In the last decade, the underlying Hedonic Pricing Method (HPM) was used in several studies, identifying the increase in property values by their proximity to water (Lutzenhiser and Netusil, 2001; Mahan et al., 2000; Phillips and Goodstein, 2000). White et al. (2010) state that the presence of water is a strong predictor of preference in urban environments and can exhibit similar effects to natural environments containing water. Urban environments with water are rated even higher than natural settings without water. Important aspects of urban environments with water are an increase of interest, attention and restorativeness.

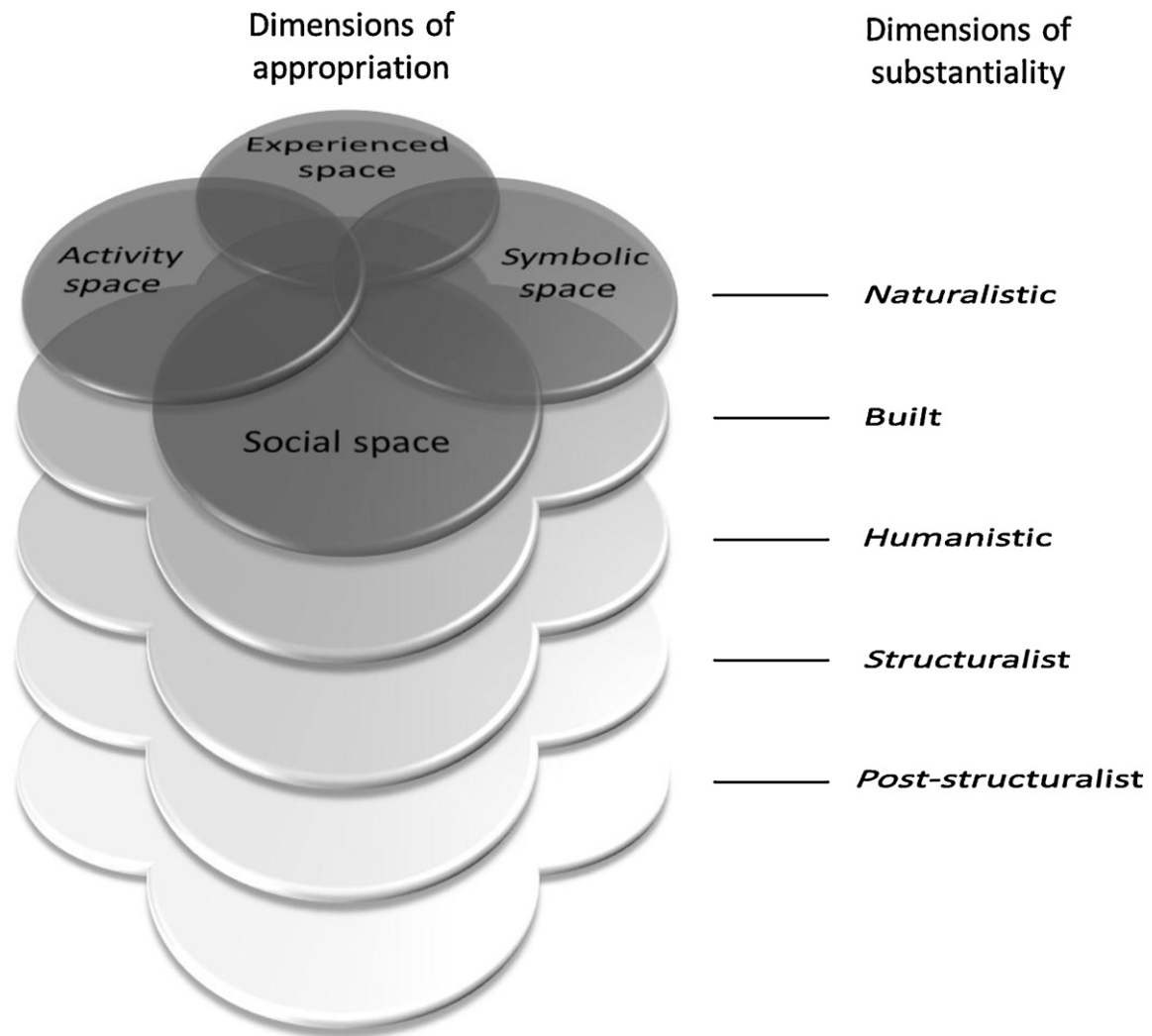
Today town developers are well aware of the value of water features. This is proved by a large number of plans that include water bodies (Wakefield, 2007). Urban planners use the immediate effect of water features differently compared to green areas, which need time to mature. The high value of water makes areas with water promising candidates for private financing or joint public-private financing. This effect is more difficult to demonstrate for parks or recreation areas (Luttik, 2000). The creation of sizeable water bodies in parks or recreation areas and the introduction of flowing water into urban environments have already been suggested (Herzog, 1985; Luttik, 2000). Town developers already focus on designing at waterfronts to enhance restorative effects (Karmanov and Hamel, 2008; Stokman and Klaus, 2006). Due to the fact that waterways are a strong predictor of aesthetic preference (Dramstad et al., 2006) and cities developed historically mainly on riversides (Strauss, 2002), the salutogenetic health effects caused by urban waterways or urban blue space (Kistemann et al., 2010) need to be investigated. The evaluation of urban settings for recreational activities such as swimming or picnicking still neglects non-monetary aspects such as the social, psychological and spiritual dimensions (i.e. coherence or mystery) of health and well-being (Burmil et al., 1999; Kochtitzky et al., 2006; Spink et al., 2010). Therefore a systematic concept to assess salutogenetic health effects is required as a tool for both town and landscape developers and for environmental health researchers.

#### *A concept for assessing salutogenetic health effects in blue space*

Landscape is defined as an "inherently dialectical relationship between physical reality and metaphoric and social construction" (Abraham et al., 2010, p. 60). Therefore landscape is perceived differently due to its link to meaning, identity, attachment, belonging, memory, and history (Abraham et al., 2010; Davenport and Anderson, 2005; Frumkin, 2003; Macintyre et al., 2002; Parsons and Daniel, 2002). When assessing the salutogenetic health effects of blue space these categories have to be taken into account.

The concept of therapeutic landscapes provides a framework to assess the health benefits of blue space. It is a multi-dimensional approach to identify salutogenetic health effects in the landscape (Gesler, 1992; Williams, 1998). It covers all categories of landscape as well as the categories of this review. The term therapeutic implies a pathogenetic background, but this does not thoroughly describe





**Fig. 2.** Concept to characterise, analyse and understand salutogenetic health effects in blue space. The four dimensions of appropriation are complemented by five dimensions of substantiality in a matrix of therapeutic landscapes.

the primary aim of the concept to promote health (Kearns and Moon, 2002). However, a therapeutic landscape is not necessarily beneficial to everyone and should therefore be considered rather as a “potentially therapeutic landscape” (Conradson, 2005, p. 346). Collins and Kearns (2007) even found a parallelism of sites being healthy and unhealthy at the same time, depending on the feelings and viewpoints of the visitors. In certain studies, water is used practically as an element in a therapeutic landscape (Foley, 2010; Gesler, 2003; Gesler and Kearns, 2002). We propose an enhanced concept to characterise, analyse and understand the salutogenetic health effects of blue space that stretches the concept of therapeutic landscapes. It distinguishes four different dimensions of appropriation: the experienced, social, symbolic, and activity space dimensions and five ontological dimensions of substantiality (see Fig. 2).

In the appropriative dimension of *experienced space*, mainly natural and built environments are considered, as in Gesler’s (1991) physical space. Khachatourians (2006) noted the striking key issues of this dimension: territoriality, the beautiful natural environment, water, identity/sense of place, removal from everyday stress, and place meaning. In our review these categories are covered under ‘perception and preference’ and ‘landscape design’.

The dimension of *social space* considers key issues like shared rituals, pilgrimage, contested reality, historical context, everyday activities, relative equality, social relations, and the reputation for healing. This dimension is described within the sections

‘perception and preference’, ‘emotional benefits’ and ‘direct health benefits’.

By using the term ‘spiritual space’, Gesler (1991) focused on symbolism, a healing god, supernatural healing powers, the origin of a spiritual nature, the role of faith, transformation, and beliefs, philosophies, expectations and perceptions. This approach focuses exclusively on the religious and therapeutic meaning of landscapes focussing explicitly on healing, although symbolism and philosophy are also included. In our concept this dimension is labelled *symbolic space* and includes the results of the ‘emotional benefits’ section and relates more strongly to salutogenesis and health promotion.

Williams (2002) stated that health geographers “move away from viewing place as a physical landscape, and towards a relational view in which space is implicated as human activity or vice versa” (Williams, 2002, p. 148), but does not implicate the idea of human activity in the concept of therapeutic landscapes explicitly. We propose to enhance the three dimensions of space and key elements of therapeutic landscapes by a fourth dimension of appropriation, which particularly considers human behaviour and activity in space. Regarding the high level of recreational use and the high impact of recreational activities on health in blue space, the *activity space* dimension needs careful attention. This includes active and passive recreational activities, supported by or linked to blue space. The various recreational possibilities in

blue space are described in the section 'restoration and recreational benefits'.

Blue space can be analysed using a set of at least five different *dimensions of substantiality* as an analogy to different levels of abstraction. Classen and Kistemann (2010) compiled the naturalistic (e.g. fresh air and healing wells), the built (e.g. riparian buildings and clinics), the humanistic (symbolism, importance, sense of place, and meanings), the structuralist (corporate agreements on power, control, accessibility, and territoriality), and the post-structuralist substantiality (discursive construction of knowledge and experience) to analyse therapeutic landscapes. All defined spaces can be analysed within each dimension of substantiality, resulting in a systematic theoretical framework for environmental, salutogenetic health research. The concept aims to support practitioners to notice above all the diverse impacts of blue space on health and well-being.

## Conclusion

Despite striking results showing that blue space has manifold influences on human health and wellbeing, research in blue space is still at best a by-product of environmental psychology and environmental health research. Emotional and experiential responses to blue space have not yet been adequately recognised. Against this background and as an innovative take on therapeutic spaces in urban areas, we suggest introducing 'blue' as a new colour (both literally and metaphorically) into debates on environmental health and therapeutic landscapes.

Based on the results of the literature review addressing the certain, blue component of therapeutic landscapes, an innovative, two-dimensional matrix, comprising appropriative dimensions of places (experienced space, activity space, social space, symbolic space) and ontological dimensions of distinct substantialities (natural, built, humanistic, structuralist, post-structuralist, see Gesler, 1992, Classen and Kistemann, 2010) turned out to be a beneficial instrument for an improved understanding of the multifaceted, affective character and impact of landscape as a therapeutic, i.e. health-relevant entity. As the matrix is not specific for blue spaces, it may also prove worthwhile for wider applications.

A range of specific empirical and experimental settings could be identified for future work. Namely, more research needs to be carried out on the emotional and experiential response to blue space. The concept suggested may help both researchers and practitioners analysing the health effects of blue spaces. It remains a challenge to stretch the concept to marine environments, which have not been included into this paper.

Urban environments, although the everyday environment for most of us and therefore important for any goals towards health promotion, are underrepresented in current literature on blue therapeutic landscapes. Health benefits could clearly be identified, but there is still little respect for water and health in urban planning issues. There is a need to introduce the prospective findings from environmental health research concerning blue spaces into urban planning and landscape architecture.

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