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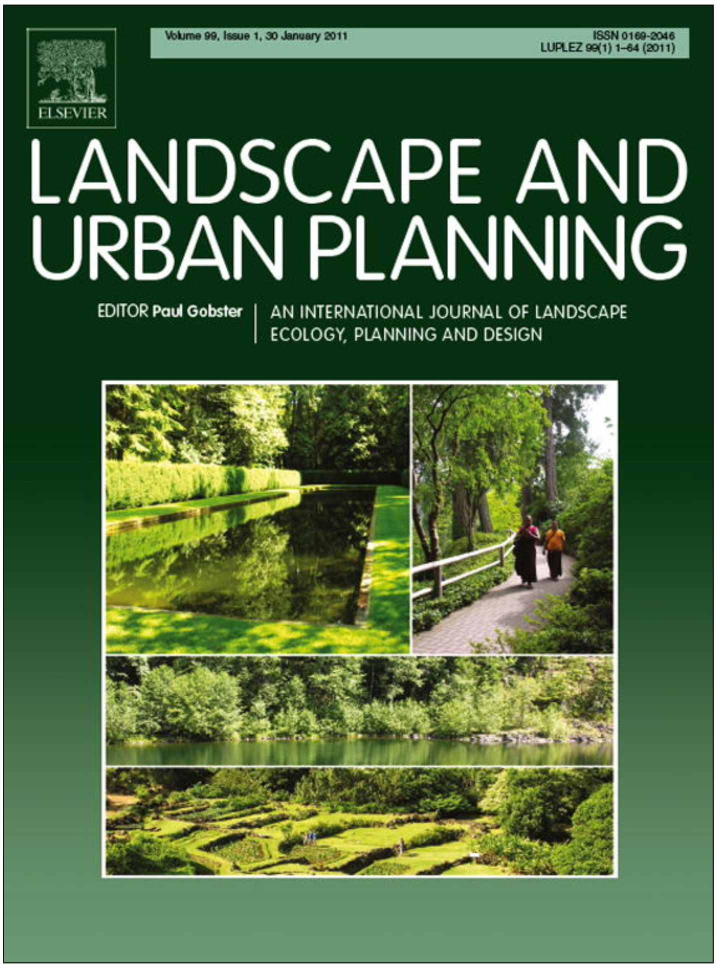

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Fish in a mall aquarium—An ethological investigation of biophilia

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ABSTRACT

A wide range of studies have generally found that humans appreciate certain characteristics of natural habitats, in particular the presence of other living vertebrates. This "biophilia" may reflect evolved adaptive preferences, preferences that may continue to affect our behavior today. The present study examined whether urban Europeans pay increased attention to natural stimuli even in an unnatural environment. An aquarium was installed in the window display of a Vienna, Austria, shopping mall and its effect on the responses of passers-by recorded. Assessment was by review of videotapes and quantification of duration of stay in front of the window, periods of facing the window, and such communications as pointing in the presence of others. The total number of episodes quantified was 1002 out of a total of 12,921 persons on the videotapes. As expected, all the behavioral measures of attention and exploration that were assessed indeed increased when the aquarium was present. These findings bear implications for marketing, and moreover, for ameliorating the stress that modern city environments may place on the ancient human organism.

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1. Introduction

In 1984 Edward O. Wilson postulated that there is an innate human tendency to "biophilia"—to preferentially focus on life and lifelike processes in perceptual fields of any complexity. Stripped of ethical and moral connotations (e.g. Kellert, 1993; Wilson, 1993), biophilia can act as a framework for uniting hypotheses of landscape aesthetics, aspects of restorative environments, and observations of human–animal interactions with sturdy findings from urban ethology. The present paper is a modest contribution to that unitary framework.

As exemplified by the diversity of professional and intellectual backgrounds of the contributors to the recently published book "Biophilic Design" (Kellert et al., 2008), many fields study humans in interaction with their environments at many different levels of analysis. Psychologists and behavioral scientists assess cognitive performance and self-reports about preference, aesthetics and well-being in natural and urban settings. Others measure physiological reactions such as skin conductance and blood pressure, or observe behavioral manifestations such as self-chosen duration of stay, frustration tolerance or aggression. Painters, architects, landscape architects, urban planners, and others contribute different practical implementations. Despite this diversity, we believe that many aspects described are the expression of the same underlying factor, which can be named biophilia.

1.1. *The framework of biophilia—evolved preferences for landscape features and their empirical manifestations in many disciplines*

In contrast to natural environments, modern cities are characterized by a predominance of dead structures (Eibl-Eibesfeldt, 1995); yet many studies have shown that humans so strongly prefer the natural over the built environment that distributions of expressed preference nearly fail to overlap (e.g. Kaplan et al., 1972; Ulrich, 1981). For instance, when asked to describe their ideal city, students more often chose non-urban characteristics, especially greenery (Félonneau, 2004); in a completely different domain, Luttik (2000) demonstrated that a pleasant view can considerably raise the price of a house. Such evolved responses to landscape are one conceptual overlap among habitat theory (Appleton, 1996), the concept of the Environment of Evolutionary Adaptedness (EEA) (Durrant and Ellis, 2003; Symons, 1990; Tooby and Cosmides, 1990) and the Savannah Hypothesis (Orians and Heerwagen, 1992). Preferred settings share features such as water, plants, or animals and elements of mystery and prospect-refuge (Orians and Heerwagen, 1992).

A possible reason for this general preference for natural settings might be that they demand fewer processing resources inasmuch as our brain and sensory systems evolved in and are adapted to natu-

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ral environments (Wohlwill 1983 as cited in Ulrich et al., 1991). Alternatively, natural settings might fascinate by virtue of their content per se, or perhaps they have a benign, restorative character. Ulrich and colleagues (e.g. Ulrich, 1979, 1984; Ulrich et al., 1991) as well as Bringslimark et al. (2009) review a large and consistent body of physiological and questionnaire data on the effects of non-threatening natural settings, passively viewed, on stress and on well-being. On the other hand, attention restoration theory (ART) distinguishes between voluntary and involuntary attention; the latter is necessary for recovery of the former, and is fostered by exposure to natural views (Kaplan, 1995b for a review). Both blood pressure and attention deficits tend to increase in the urban condition and decline in the natural condition (Hartig et al., 2003). The same holds for frustration intolerance (Cackowski and Nasar, 2003), and children with Attention Deficit Disorder (ADD) have less severe symptoms the greener their play area (Taylor et al., 2001).

Incorporating natural elements into buildings can have a positive influence on psychological, physical and social well-being. The effects of indoor plants are well documented in the extensive literature review of Bringslimark et al. (2009). With regard to water, Ruso and Atzwanger (2003) observed that people stay longer near the fountain in a shopping mall. They move toward the fountain and become likelier to explore and to interact when the fountain is filled with water as compared to an empty one. Herzog et al. (2000) found that the river category is most preferred within landscapes. Another hint for the human fascination with aquatic environments is that one-fourth of all outdoor recreation is water-dependent (Pitt, 1989).

In 1992 Orians and Heerwagen pointed out the lack of studies on the relationship between preference ratings and animals in the landscape, guessing that researchers tend to leave them out because their presence and changing position even in still pictures are detected so quickly and more accurately compared to inanimate objects (New et al., 2007; Thorpe et al., 1996), and because they probably enhance preference scores. The remarkable popularity of zoos and aquariums (Kellert, 1997) is consistent with the epidemiological evidence regarding health benefits from pets (Friedmann et al., 2000 for a review), and in the case of patients with mental disorders the entry of animals into a purely human environment results in more focused attention, increased social responsiveness, positive emotion, and more speech acts (Katcher and Wilkins, 1993).

We assume, like most of the authors we just reviewed, that biophilia—the tendency to focus on life and lifelike processes—has evolved because it led our ancestors to seek out places favorable to their survival and well-being. Even though it might not be an evolutionary significant adaptation to modern urban habitats, it will still guide our perception, attention and behavior. As fewer than 200 generations have lived in these modern, highly artificial, environments, the old biological predilections persevere (Buss, 2008). The empirical studies summarized above show that biophilia is manifested in a variety of ways. Water, vegetation and animals are highly valued components in landscape aesthetics (e.g. Orians and Heerwagen, 1992); they foster cognitive and physiological well-being and enhance social interactions. Past findings are predominantly based on subjective ratings and single individuals, whereas we have approached biophilia via classical ethological methods, and also assessed the social context—both prosocial behaviors, such as pointing gestures, and the behavior of people around the focal subject.

1.2. Direct behavioral observation—the (human) ethological approach

We wanted to study all this without asking questions. For this and other reasons summarized by Richards and Bernal (1972) and Webb et al. (1966), our work emphasizes direct behavioral observation: By using a hidden video camera in a real-life setting, we avoid the biases and behavioral alterations that come into play whenever people are aware they are part of an experiment, such as the emphasis of culturally desirable responses. And we can observe people in much more detail than they themselves can recall (Zajonc, 1980). Direct behavioral observation complements all the physiological data and rating studies reported in the literature and helps complete the picture of human living under urban conditions.

A proper ethological study, no matter whether it is of animals or humans, requires an unobtrusive measurement of behaviors. This means a codebook of clear, comprehensive and unambiguous categories of behavior (free of interpretations) as well as an appropriate sampling frame (whom to watch) and recording rules (when to watch), and the application of a consistent measurement procedure throughout all observations (Martin and Bateson, 1993). Only this procedure allows an objective assessment of the behavior of people who are unaware that they are being observed.

1.3. Objectives and predictions

This study aims at testing the hypothesis that even in cities that lack natural elements, people still want to affiliate with nature, however artificial the surroundings. The connection of biophilic stimuli and the self-chosen duration of stay (as opposed to e.g. working places or hospitals) has been investigated only in the context of urban squares (Atzwanger and Schaefer, 1999; Schaefer et al., 1999), so that we can now add our piece to the investigation of cross-situational consistency of biophilic behavior. Because our concerns center on the consequences of biophilia in human behavior and social interactions, we chose an aquarium that combines water, vegetation and animals, and placed it in a window display in a shopping mall. We thus use only a very small fraction of the environment as biophilic stimulus.

In our study design, the behavior of people in front of this window display is then compared between times of presence and absence of the aquarium. We expected that passers-by will respond by showing behavioral indicators of increased interest (i.e. more stopping, longer duration of stay, longer visual inspection of the window display, more pointing gestures) when the aquarium is on display. As it is not only the physical environment that affects human perception and activity, our study is the first to focus on social interactions and dynamics with regard to biophilia in everyday behavior of non-clinical subjects. People are expected to become likelier to stop when others stop (e.g. Milgram et al., 1969). For the interaction of density of shopper with stopping behavior, we have no a-priori assumption: people might leave faster to avoid the stress of being in the midst of crowds, might not be influenced by density, or might prolong their duration of stay in line with the idea of an aquarium as restorative setting.

2. Materials and methods

2.1. Participants

Our sample consisted of visitors to an urban European shopping mall (Shopping City Süd, near Vienna, Austria) in 2003. Their estimated ages ranged from 4 to 77 years, not including children in carriages. Just over half were male.

2.2. Location and stimuli

Shopping malls have the advantages of relatively constant artificial conditions of lighting and air flow and a huge sample of potential subjects (passers-by). The window display of 3.85 m width and 2.60 m height belonged to a gift shop that sold fancy dishes and furniture; the main feature of the window was a table

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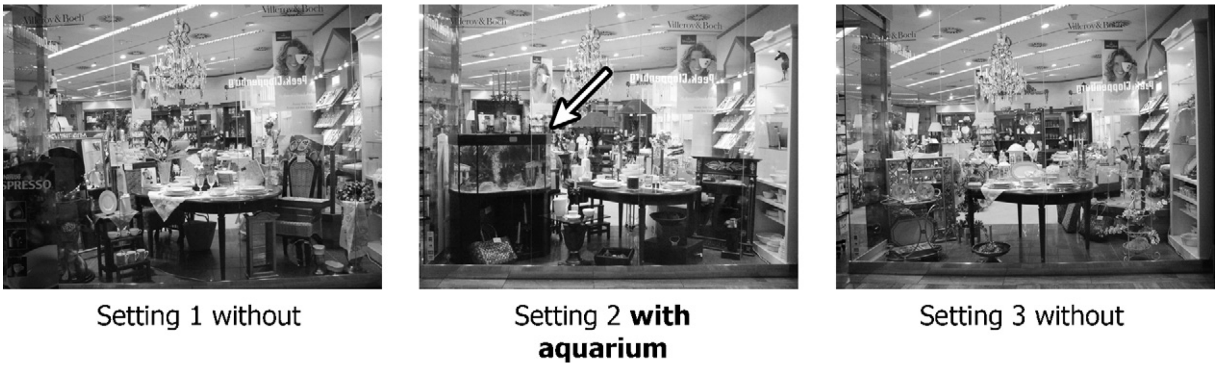

Fig. 1. Experimental setup—the window display. The photographs show the window display and its dressing: before, with and after the aquarium in place (*from left to right*). These photographs were taken perpendicular to the line of the window display. The aquarium incorporates water, vegetation and animals—all highly valued components in landscape aesthetics. The arrow (*middle panel*) points to the upper right corner of the aquarium.

with dishes and other accessories. The window dressing changed slightly during the observational period and was not identical before and after the insertion of the aquarium (Fig. 1). This resulted in three settings. Artificial but natural-looking plants were present in every setting, but were especially prominent in the third. The 180-l aquarium (100 cm × 45 cm × 60 cm, flattened corners) sat on a 70 cm high pedestal placed at an angle of 40° (to build a deflected vista) at 30 cm from the corner of the display window. It included 13 colorful fish along with plants (toward the face away from the viewers) and some stones and other objects. The aquarium was shiny blue. In the water, bubbles were rising.

A small video camera (26 mm × 87 mm) was connected to an ordinary video recorder invisible from outside the window. It filmed a trapezoid shaped part of the arcade. A banister at a distance of 4.40 m from the window display formed a natural boundary behind the area under study, which was approximately 33.3 m^2 (Fig. 2). Standing at the banister revealed a view onto the lower floor (hatched area in Fig. 2).

2.3. Data collection, sampling and recording rules

Data collection consisted of three phases—before placement of the aquarium, during its run, and after it was removed. We analyzed video from 11 a.m. (an hour after opening) until 5 p.m. (an hour before closing) from May 19th to July 26th, 2003. In these 54 days there were three episodes of video cassette failure and three days lost to installation or removal of the aquarium. For behavioral analysis, days and hours were selected at random for the aquarium setting and then matched for the others. All comparisons were thereby balanced by day of the week and time of day. Observation time was limited to 1 h per day. This resulted in 20 h of video for coding; coding took 10 h per hour of real time. There was only one coder for all the videotapes. She brought herself up to criterion (total agreement on frequencies and within 0.5 s replication of event timing) by extensive training sessions.

Focal sampling was combined with continuous recording from the subject's entering until leaving the research area (Altmann,

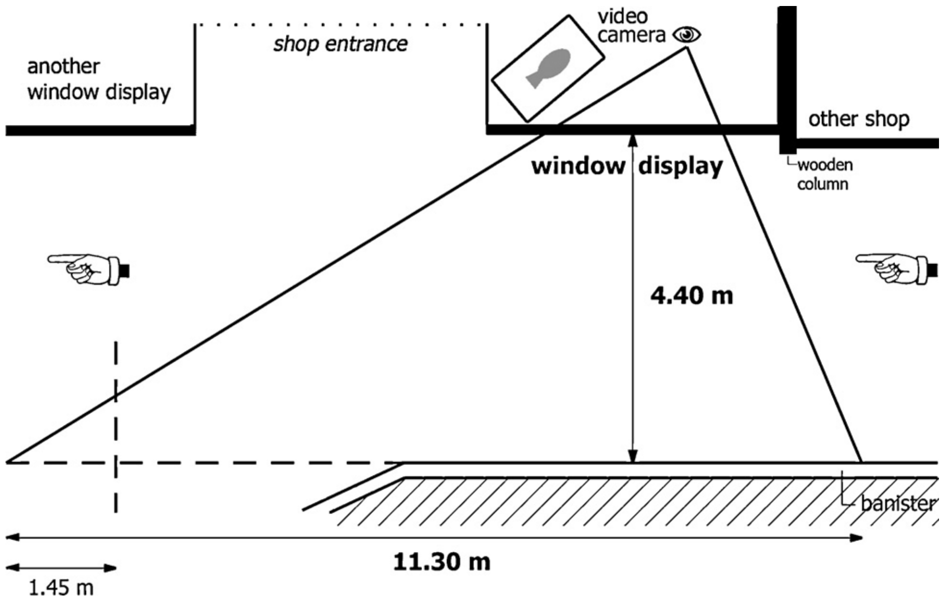

Fig. 2. Schematic top view of the research area. The fish in the window display specifies the position of the aquarium. The banister formed a natural border that was extended theoretically, as symbolized by the horizontal dashed line (with the hatched area indicating a free view onto the lower floor). Due to partial obstruction of the observer's view, the area under study was actually smaller than the one the camera angle would allow for, as indicated by the vertical dashed line. The finger points in the direction of the pedestrian's flow observed.

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Table 1
List and definition of the behavioral items scored. Items of behavior were operationalized by descriptions trying to avoid functional interpretations.

Behavior	Definition
Stay	Time the focal subject spends in the research area from the moment that any part of the body becomes visible until completely vanishing.
Face	Orientation of the head towards the window display so that more than one half of the face is visible (meant to be an estimate of looking at the stimuli).
Stop	The contact zone of the feet and the ground does not change for at least 0.5 s.
Go back	Changing the direction of movement parallel to the long side of the shopping window display followed by a turn of the head towards the window display.
Point	Movement of the arm, which makes the finger point in the direction of the window display.

1974; Lehner, 1996). Contextual data was included via scan observation. Because there is a parting of the ways on one side (the right side from the camera's view; the left side in Fig. 2), left-moving passers-by had unstandardizable options to approach the window display. Thus, for the sampling and coding, only persons moving from left to right could be considered. From these right-moving people, focal subjects were chosen systematically by picking every 25th passer-by. The number 25 was a compromise between a high sample size per hour video cassette and a low degree of overlap between focal subjects. In addition, the behavior of every stopping single person was coded (if a group stopped, we coded the first person to stop). We decided on these two different systematic sampling strategies because only 26 of the 507 focal subjects (picked every 25th from 12,921 passers-by) stopped. Yet, stopping is probably the most important correlate for interest and exploratory tendencies, especially when considering that other strong indicators of attention such as pointing gestures and going back hardly ever occurred without stopping. Therefore, an additional 495 persons were coded due to stopping, which, along with the 26 focal subjects who stopped, totals 521. Individuals were excluded if their means of locomotion was other than walking (e.g. roller-skating, wheelchair), if they accompanied someone who was already a focal subject, or if they were re-entering the research area after having left.

2.4. Measuring behavior

Behavioral categories were built and described following Schaefer (1997), Mehrabian and Russell (1974), Blurton Jones (1972) and Leach (1972). A detailed description of variables is given in Table 1.

Behaviors such as turning to the window display, facing the aquarium, stopping and tactile interaction were quantified by duration and frequency. "Frequency" here refers to the total number of occurrences of the behavior pattern during the focal individual's stay in the research area. "Duration" stands for the total length of time of all occurrences of the behavior over the whole duration of stay.

We coded contextual data such as the time at which the focal individual entered the research area, estimated age and sex of the focal subject, the number of persons accompanying him/her and their perceived social relationship, the number of accompanying persons who stopped and the number of people who were standing in the research area when the focal subject turned up. The identification of groups in the streaming of passers-by was assessed based on (a combination of) proximity, visual and bodily contact, body orientation, gesticulation, and talk (for a recent reference see Costa, 2010). Perceived social relationship was categorized as: accompanied by child/children (up to the estimated age of 14), partner, peers (based on similar age), adult (if the focal subject is a child). The categories "mixed or others including a child/children" and "mixed or others without a child" were used if more than one category applied or when the relationship could not be approximated by any category.

2.5. Statistical analyses and graphics

Nonparametric as well as parametric procedures were produced by SPSS 11.5 for Windows. All parametric (duration) data were log-transformed. All conventional null-hypothesis significance testing was two-tailed, and comparisons are called "significant" whenever the computed p is less than 0.05.

Bivariate analysis of nominal data was done via cross-tabulation and Pearson chi-square. Nonparametric comparisons of duration were by Mann–Whitney test. Analysis of duration at the window was separate for stoppers and non-stoppers, and all durations of zero were omitted. Statistics are reported only as significant or not (for the hypothesis at hand); actual numerical values are available from the authors upon request.

3. Results

3.1. Controls

The three phases – setting 2 with the aquarium, setting 1 and 3 without it – did not differ statistically regarding the demographic variables of focal subjects (perceived age, sex, number of people with them: categories 0, 1, 2, ≥3, kind of company) and the number of passers-by per hour. Sample sizes for these and the following analyses are given in Table 2.

3.2. Behavior analysis

In the focal sample of every 25th passer-by, 66% faced the window display in setting 1, 70% when the aquarium was present, and 57% in setting 3. Setting three is thus significantly different from setting 2 including the aquarium, whereas 1 and 2 do not differ statistically. We analyzed the duration of facing the window display of stopping and non-stopping persons separately, as

Table 2
Stopping and pointing gestures, men, women, children and the aquarium. In the case of stopping, expected cell counts were too low to compare times of presence and absence of the aquarium statistically. Pointing gestures were analyzed within stopping individuals. All differences reached statistical significance (Pearson Chi-Square Tests, $p < 0.05$ each).

	Stopping yes/total 25th ($n = 507$)		Pointing yes/total stopping ($n = 521$)	
	Without aquarium	With aquarium	Without aquarium	With aquarium
Women	6/151 (4.0%)	7/79 (8.9%)	16/168 (9.5%)	20/99 (20.2%)
Men	6/178 (3.4%)	3/75 (4.0%)	6/121 (5.0%)	14/82 (17.1%)
Children (≤14 years)	0/14 (0.0%)	4/10 (40.0%)	0/9 (0.0%)	23/42 (54.8%)

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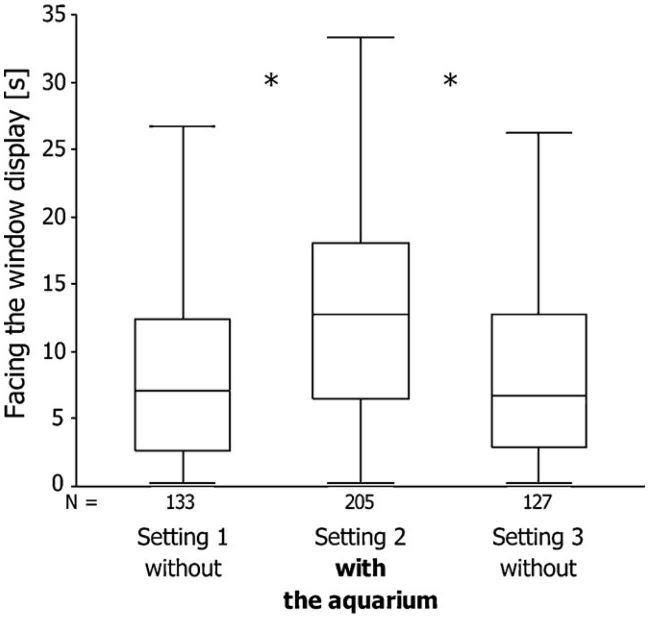

Fig. 3. Visual exploration in stopping individuals. The duration of looking at the window display was significantly prolonged when the aquarium was part of its dressing (Mann–Whitney *U*). The asterisk stands for comparisons significant at better than $p = 0.001$. Boxplots show median, 25th and 75th percentile, minima and maxima without extreme values and outliers (>1.5 box lengths from the upper or lower edge of the box).

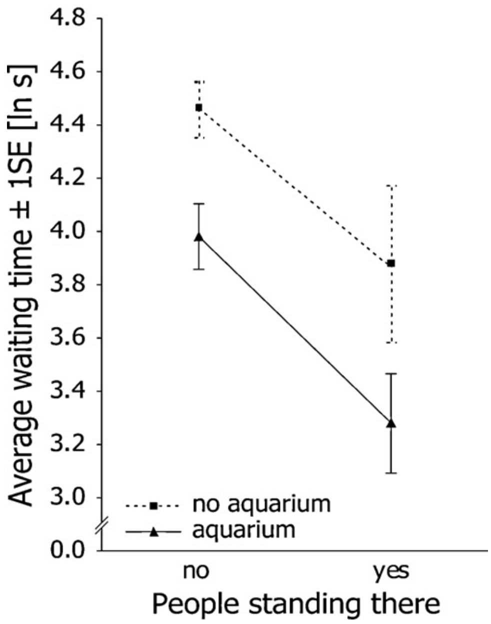

Fig. 4. A closer look at stopping behavior when density was high. Waiting time, the time span between stopping focal subjects, was found to depend on the presence of the aquarium and the presence of other people already standing there ($p < 0.05$ each; $n = 305$) in the more crowded condition. There was no interaction between these factors. Error bars represent standard errors (±1 SE).

stopping individuals generally looked at the window for a longer time. Focal subjects passing by without stopping faced the window display for equal amounts of time in settings 1 and 2, i.e. before and with the aquarium, and significantly more briefly in setting 3, i.e. when the aquarium was removed again. In contrast to this, individuals who stopped looked at the window display for significantly longer periods when the aquarium was shown (Fig. 3) than in settings 1 and 3, when it was not. The geometric mean of the log-transformed durations actually increased by 84% when the aquarium was part of the window dressing and decreased by 66% when it was taken off again. Men and women did not differ significantly in the duration of facing the window display within each setting. Sample sizes were too small to allow for comparisons in children.

The proportion of people who stopped in front of the window display when there was no aquarium, i.e. in settings 1 and 3, was equally high, as was their duration of stops. Thus, data were merged for the following analyses. When the aquarium was present, people were considerably (and significantly) more likely to stop. The proportion of individuals stopping then increased from 3.3% to 8.5%. When the aquarium was present, women and children were more than twice as likely to stop, while there seemed to be no analogous effect of the setting for men (Table 2).

For the stopping individuals, duration of stops was significantly prolonged when the aquarium was on display, with a change in median of 16%. The duration of stops ranged from 0.6 to 481 s with a median of 6.1 s when the aquarium was present as opposed to 5.1 s when it was not shown. The first quartile was 2.8 s as compared to 2.3 s and the third 12.4 s as compared to 9.2 s. Pointing gestures by the focal subject were noted more than three times as often in the aquarium condition (26%) as in the non-aquarium condition (7%). For more detail, see Table 2. Also, people who stopped were twice as likely to return to the window in setting 2 as in settings without the aquarium on display (18.4% versus 9.4%; statistically significant).

3.3. Density and loitering effects

We counted the number of right-moving passers-by per hour as a measure of attendance ("density", "crowding"). The 20 h of behavioral coding were split at the median of 9.8 right-moving passers-by per minute into a high-density condition averaging 13.6 per minute and a low-density condition averaging 8.0 per minute. As traffic flowed equally in both directions, the actual count of moving individuals should be approximately twice these values. We used "waiting time"—time passing between stopping focal subjects—as a measure of how likely people were to stop. We studied the logarithm of waiting time in a 2×2 analysis of aquarium (present or absent) by loiterers (no other persons standing in front of the window display versus one or more) separately for high- and low-density conditions.

A significant aquarium effect was observed only when the pedestrians' flow was relatively high, but then it was as strong as the effect of one or more persons already standing there (Fig. 4). In fact, the presence of the aquarium reduced waiting time by 62% in the absence of people already standing there and by 82% in their presence. (These percentages do not differ significantly.) When density was low, having strangers who stopped close by reduced the waiting time significantly, while aquarium and non-aquarium settings did not differ.

4. Discussion

4.1. General discussion

In general our expectation of an "aquarium effect" was confirmed. The proportion of people who stopped in front of a window display of a gift and furniture shop more than doubled in the presence of the aquarium, and those people lingered longer. They were more likely to use pointing gestures and to return to the window display. Also, we found an interaction with density of passers-by. When density was high, the aquarium was as effective at making people stop in

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front of the window display as was a person already standing there.

Only one of the settings without the aquarium had significantly fewer people looking at the window display than with the aquarium. The *percentage* of passers-by glancing at a window display in a shopping mall, however, is likely to be independent of its content and just due to visual scanning of the environment. The differences in looking times of individuals *not stopping*, might merit further consideration. In setting 1 without aquarium, the setting that yielded similar looking times to the aquarium condition, there were two gold torsos of naked men, one 15 cm tall and one twice that height. Unfortunately, the cost of having a real-life situation was to have very limited say in the decoration of the window display. It is thus even more impressive, that the *proportion* of shoppers who stopped in front of the window display was increased only when the aquarium was present. The same holds true for the duration of facing the window display when stopping, the duration of stops, and the number of pointing gestures and episodes of going back to face the window display. Supplementary analysis also shows that a person accompanying a focal subject who stops, is more likely to stop himself. So the effect of the aquarium on passers-by is actually amplified. These behaviors were seen only to increase when the aquarium was present; one can reasonably infer that artificial plants in settings 1 and 3 have less effect than the aquarium.

Generally, places that invite exploration should be indicated by longer stays, while rejection would accordingly be indicated by rapid departure. Urban squares offering more vegetation and a fountain received higher ratings of preference and aesthetic appeal, and people linger longer there, too (Atzwanger and Schaefer, 1999). That men as opposed to women and children were not more likely to stop in the aquarium's presence, a fact evolutionarily puzzling with regard to sign-stimuli indicative of environmental conditions favorable to survival, is in line with the finding of Underhill (2000) that men were much more goal-oriented in shopping behavior. If one were to speculate on how sex differences in "shopping behavior" might correspond to evolutionary scenarios, the sexual division of labor (Panter-Brick, 2002) between hunters (men) and gatherers (women) comes into mind. Hunting requires fast movement through the landscape and a quick decision on whether or not there are prey. Gathering, on the other hand, often involves detailed inspection (e.g. picking only ripe fruits and berries). Differences in spatial orientation strategies between men (*large scale orientation*, e.g. a primarily Euclidean or orientation strategy based on distances, vectors, and cardinal directions) and women (*small scale orientation*: topographical strategy using landmarks and relative directions) have been attributed to the same principle (Silverman and Choi, 2006; Silverman and Eals, 1992). A shiny blue aquarium in a window display is definitely a good landmark in a shopping mall, as are stairways and particular shops.

The oblique position of the aquarium incorporates known preferences in landscape aesthetics such as deflected vista (Appleton, 1996), mystery (Kaplan, 1992), and focality (Ulrich, 1983). Langlois et al. (1987) took looking times as an indicator of visual preference and interest when testing young children. We would certainly like to interpret the increased average duration of window-facing in stopping individuals in the aquarium condition as an increased preference for an aquarium.

A window display per se is of interest for some people. Nevertheless, that the likelihood of observing pointing gestures trebled, and that of going back doubled, when the aquarium was present indicates that the aquarium disrupted an otherwise customary action—a strong indicator of attention. Humans point in order to focus attention on a spatial region and to deliberately achieve joint attention (Bangerter, 2004). Our finding suggests that natural, moving stimuli merit our consideration more than any of the artificial ones presented.

The shift towards more children stopping in the aquarium condition might just show that the shopping window per se did not contain anything arousing their interest. On the other hand, there is some previous theory to support an evolutionary interpretation of children's attentional processes (Balling and Falk, 1982; Coss et al., 2003; Orians and Heerwagen, 1992).

Humans are known to use social cues for attention orienting (e.g. Bayliss et al., 2004; Langton et al., 2000 for a review). The increased likelihood of stopping where others have already stopped replicates what Milgram et al. (1969) showed in a simple experiment. Their subjects were prompted by not an aquarium but a stimulus crowd varying in number looking up at a building. There, too, those who looked up (the less demanding action) outnumbered those who stopped (the more demanding action). As these behaviors disrupt moving on, stopping and going back prove particularly powerful indicators of increased attention and willingness to explore the environment.

By considering pointing gestures and the influence of density and loitering on the most prevalent behavior of paying increased attention to the environment, namely stopping, this study was the first to take the people "around" the focal subject into account. Our finding that the aquarium affected people's stopping behavior in high-density conditions only, and in that condition just as effectively as the presence of other stopped people, is surprising. It might be a compensation for the shortage of personal space and for the overload of information and stress that may result from being in the midst of crowds (de Jonge, 1979; Stokols, 1972). Bear in mind that the actual density of persons averaged 27 per minute in a four-meter-wide passage. Frequent violations of personal space were therefore likely. For the effect of such violations on stress (indirectly measured) in malls, see Ulrich et al. (1991).

An aquarium possesses all the key qualities of a restorative environment listed by Kaplan (1995b): *fascination* (attracting involuntary attention), *being away* (conceptional rather than physical transformation), *extent* (rich and coherent enough to constitute a whole other world) and *compatibility* (no interference with one's goals). To continuously renew attention to an external focus, perhaps due to the movements of the animals, facilitates relaxation and requires no prior training (Friedmann et al., 2000). In contrast to erratic movement and sudden change, movement patterns associated with safety show "heraclitean" motion that is "always changing, but always remaining the same" (Katcher and Wilkins, 1993, p. 176); fish seem a perfect example of this. There is indeed a specific literature in print about the relaxing effects of watching an aquarium (Katcher et al., 1983, 1984); but compare DeSchriver and Riddick (1990).

4.2. Limitations and prospects for future research

By measuring unobtrusively, our study avoided the biases in behavior that arise when one knows that one is observed (Richards and Bernal, 1972). Webb et al. (1966, p. 1f) put the problem with particular clarity: "Interviews and questionnaires intrude as a foreign element into the social setting they would describe, . . . The goal is not to replace the interview but to supplement and cross-validate it with measures that do not require the cooperation of a respondent and that do not themselves contaminate the response." The price of unobtrusiveness is of course lost precision of the physiological or introspective data we are blocked from gathering.

In this study, as in any study of collective behavior, there is a problem about selecting "the" proband out of a group. Who is the first to stop, and did s/he respond to subtle signals such as changes in walking speed on the part of the others, whose behavior we were

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not coding? But these concerns do not confound the main effect of the aquarium (setting 2 versus the others).

We often heard the argument that it is just motion, not biophilia, that explains why humans pay attention to the aquarium. In studies of biophilia it is often difficult to conceive of a control condition (e.g. Kahn, 1997; Kaplan, 1995a; Soulé, 1993). In short, if we considered seriously whether the explanation here was true biophilia instead of mere novelty or motion, for instance (Heerwagen and Orians, 1993), by what further design could such a claim be tested? A study of small moving colored blocks might actually work its effect by their similarity to animals (Kahn, 1997).

A longer answer—might come in the form of a thought-experiment: what could possible "control" conditions be? We might go for decomposing and separate testing of characteristics such as form and motion, i.e. a poster of fish, mobile, a pendulum clock, or an aquarium motion fish lamp night light as sold in toy stores. Human behavior might be understood as the output of adaptations, which are themselves the constructed product of selection under ancestral conditions (Tooby and Cosmides, 1990). And indeed, there seems to be something special about biological motion since humans activate different brain regions than do moving tools (Beauchamp et al., 2003). Both videos and point-light displays of humans elicited greater response in the superior temporal sulcus (STS) and the lateral fusiform gyrus, whereas the middle temporal gyrus (MTG) more strongly responded to tool movements. The authors suggest that the degree of articulation might play a crucial role. But back to our thought experiment: would a poster or a mobile lead to an increase of attention indicators? If not, we need real fish. If yes, what would it mean when they attract our attention? Perhaps that our perceptual machinery generalized to more abstract stimuli so as not to miss a real event (Haselton and Nettle, 2006).

A central question emerges: Is there something about living objects that has a special attraction for our gaze, which cannot be explained by their physical properties? One hint in favor of an affirmative answer may be that people tend to keep fish, and not moving models of fish (Katcher et al., 1983), and even the artificial ones are made to look and behave as realistically as possible (see our screensavers and all kinds of artificial aquariums). Still, the share of motion in explaining humans' paying attention to the aquarium remains an open question to be pursued in future research. Additional studies might include exploration of the components of the aquarium as a composite stimulus.

4.3. Practical implications in modern cities

For retailers, it might be worth thinking about paying people to stand in front of their shops, as people already stopped seem to be the most effective stimulus to make people stop. On the other hand, at times when it becomes increasingly difficult for retailers to create a differential advantage, the attributes of the store may provide an opportunity for differentiation, and what would be better than one that fosters well-being? An aquarium helping to create a restorative window dressing would be a pleasant alternative to information overload. Window displays are suspected to be of not only informational but also recreational use (Sen et al., 2002).

But there is more to it than the retailer's interest. Mehrabian and Russell (1974) found positive correlations among measures of preference and measures of expressed desire to affiliate in a situation (to be friendly and talkative to a stranger who happens to be near you, to initiate a conversation just to be friendly). Dwelling satisfaction is strongly positively correlated with the frequency of prosocial interactions, the degree of acquaintance, the feeling of security—and the duration of stay in places in front of residential apartment blocks (in Vienna, Schaefer et al., 1999). The duration of stay in urban squares, in turn, is found to increase with the degree of grassy area including bushes and the presence of a fountain (in Vienna, detailed analysis in Schaefer, 1997; in Munich and Vienna Atzwanger et al., 1998). Analogously, nearby green areas were associated with an enhanced sense of community in the study of Kim and Kaplan (2004) in Maryland, USA. On a smaller scale, many public facilities, in addition to hospitals (see Ulrich, 1984), might benefit from fostering stress-reduction, attention, recreation, communication, and place attachment. The stress-reducing natural elements could do this in schools and kindergartens (c.f. Taylor et al., 2001), libraries, retirement homes, waiting rooms of train stations and airports, (governmental) agencies, offices and doctors' practices. Vertical gardens (Blanc, 2008) or Seattle's Waterfall Garden Park give examples that biophilic design might not require much ground.

Our study shows that even a small aquarium might make a difference and offers an opportunity to include the benefits of nature where spatial and financial resources are minimal. In contrast to mere indoor plants (see Bringslimark et al., 2009, for a review), it also includes water and moving animals. Furthermore, an aquarium represents a closed system. This might allow for its installation where hygiene standards are high (e.g. intensive care units) or allergy prevalence is extreme.

Settings that are conducive to well-being and social communication are precious in anonymous city contexts, which otherwise might foster stress, vandalism, crime or aggression through high density of people and the lack of acquaintance and place attachment. In summary, the challenge for the future will be twofold: to integrate into buildings and cities the positive biophilic features of our evolved relationship with nature, and to avoid biophobic conditions.

5. Conclusions

We found that people paid increased attention to a window display containing an aquarium, we speculated on some evolutionary reasons why such a behavior might have been adaptive in the past and might still be healthy today, and we demonstrated that even small biophilic stimuli not only invite approach and exploration but also change the quality of social interactions (e.g. pointing gestures) and interact with social dynamics. Our findings bear implications, however modest (in view of the limits of the sample), not only for shopping mall design but for all the diverse strategies by which we try to turn modern cities into liveable places by meeting human biological and sociopsychological needs. In a shopping mall where large numbers of economists try to create a setting which invites passers-by to stay, a setting full of stimuli to catch their eye, it is surprising that a small aquarium is even noticed. And yet, people turn to it, point to it, stop and stay.

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