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The positive effects of aquarium visits on children's behaviour: A behavioural observation

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Abstract

To date research has found a positive effect of blue spaces on adults' wellbeing. However, it remains to be seen whether these findings are also true for children. The present study aims to address this gap in the literature. The researchers observed children's behaviour at the National Marine Aquarium across two weeks, including one where the Big Draw event was taking place. In line with restorative theories of natural environments (Kaplan, 1995, Ulrich, 1983), the current research found the exhibit had a calming effect on behaviour and increased levels of happiness across both weeks. During the Big Draw week children stayed longer and were calmer. The results help to substantiate the current research on the restorative potential of natural environments.

Introduction

There is an abundance of research highlighting the importance of natural environments for psychological well-being in humans. It is important to identify what types of environments benefit the human population the most and how these findings can be applied most effectively. Especially when we live in a world where technological advances have seemingly decreased time spent outside enjoying natural environments, despite their many benefits.

According to Wilson (1984) humans have an innate desire to affiliate with living organisms and systems which provide life. He referred to this as the 'Biophilia hypothesis', roughly translated as love of life and living systems. The importance of water to our existence is undeniable; not only is it needed for survival it is also a reliable food source bringing with it animals and plants. In our evolutionary past it also provided a natural perimeter to protect communities from their enemies (Kahn, 1997). It is the evolutionary importance of natural elements, which is central to Wilson's Biophilia hypothesis, which he suggests is responsible for our preference for natural environments.

There is a robust body of research providing evidence for this preference. Kaplan and Kaplan (1989) found that people preferred environments that are natural rather than built, these natural environments need not be vast, parks and gardens are also included. Furthermore, built environments with water, trees and vegetation are preferred to built environments which lack these elements. Experimental research has also found that after watching a stress inducing video followed by a video of a natural environment, participants show greater stress recovery when compared to those who followed the stressful video with an urban video (Ulrich, Simons, Losito, Fiorito, Miles & Zelson, 1991). Measures were both self-report and physiological measures, providing strong evidence for the stress reducing benefits of natural environments. Ulrich (1993) observed that over a fifteen year period there were a number of complaints made by patients about the artwork on the walls of a psychiatric hospital. There were seven attacks over the years, which involved patients vandalising and dismantling art work. Interestingly these attacks were never on pictures of natural environments, thus nature was never the source of the aggressive outbursts. One could argue that this is mere coincidence. However, it is in line with the accumulation of evidence which have found a preference for natural environments and their stress reducing capabilities.

Not only are natural environments preferred to urban environments, but blue environments (those with water) have been found to be favoured over green environments. Ulrich and Lunden (1990) found that following open heart surgery those shown visual simulation of water scenes, as opposed to forest scenes, reported less post-operative anxiety. The preference for blue space still holds when it comes at a cost; people will pay 8-12% more for a house which overlooks water (Luttick, 2000) and 10% more for a hotel room which has an aquatic view rather than a view of a forest (Lange & Schnaeffer, 2001). Divers will also pay more to dive in sanctuaries, where marine life is protected from damage (Arin & Kramer, 2002). White, Smith, Humphreys, Pahl, Snelling and Depledge's (2010) study shows a substantial preference for blue environments, over built and natural green environments. This held true for both built and natural blue environments.

Attention restoration theory (Kaplan, 1995) (ART) suggests that the reason that natural environments are so beneficial to our well-being is because of their cognitive restorative potential. It gives our attention time to rest and recover. James (1892) first proposed the idea of voluntary attention. His idea was that paying attention involves a lot of effort; we have to suppress large amounts of competing information which can easily become a distraction. For example, when we are driving, attention must be paid to the road and those using it. Meanwhile, competing information such as a song on the radio, or a talkative passenger must be ignored. Neuropsychological research (Rothbart & Posner, 1985) found the prefrontal cortex is associated with directed attention, where deficits have been linked with poor inhibitory control. Kaplan (1995) modified James' idea of voluntary attention, adding a further element. This was that voluntary attention, also termed directed attention by Mesulam (1985), can be exhausted. When people spend a long time driving they tend to become drowsy and their attention capacity weakens. This is true of many tasks which require us to consciously pay attention. We also have involuntary attention which does not require effort to be made, giving voluntary attention an opportunity to recuperate.

According to James (1892) elements which are bright, moving, pretty and alive draw upon our involuntary attention. Kaplan (1995) argued that fascination allows us to effortlessly attend, and in turn rest our voluntary attention; there are many elements which draw upon fascination throughout natural environments. This increases our sense of wellbeing. A sense of being away (from ones normal life) and extent, where one can become immersed, are said to provide a 'mental vacation' (Wells & Evans, 2009). This seems to help explain why nature, and water in particular are favoured. ART has been criticised for not accounting for the social influences on the restorativeness of environments. However, research has shown that it is the natural environment itself, and not social aspects which have the relaxing and restorative benefit (Staats & Hartig, 2004).

Another influential restorative theory is by Ulrich (1983) who suggests that natural environments have emotionally restorative potential. His psycho-evolutionary model stresses the affective response we have to natural environments; those with depth, complexity, structure and water are visually pleasing (Kjellgren & Buhrkall, 2010). Due to our evolutionary past humans are predisposed to attend to natural environments, which provided food and water in our earlier stages of development; they aid inhibition of negative thoughts and increase positive emotions.

Van der Berg, Koole and van der Wulp (2003) found that natural environments have both affective and cognitive restorative potentials, thus Ulrich (1983) and Kaplan's (1995) restorative theories co-occur when attempting to explain the positive effects of nature on humans.

The research presented so far has demonstrated adults' preference and affect in relation to green and blue environments. Similar findings have been found in the child population with regards to green environments. A group of children were asked to draw a picture of their favourite place. 93% of the drawings were of outdoor spaces (Moore, 1986). Furthermore, Sobel (1993) found that both Caribbean and British children preferred to play outdoors. Evidently there is a preference among children to spend time outside in natural environments suggesting that they

genuinely enjoy it. Wells and Evans (2009) found that living in a rural environment, where natural environments were accessible, served as a moderator of life stresses in children. These stresses included bullying and moving house and school. Wellbeing following stressful life events was better for those living near nature than those where there was relatively little access to nature. These findings fit with Ulrich's restorative theory, where natural environments alleviate negative emotions, such as stress. Not only do children prefer natural environments but it is beneficial to their wellbeing.

Faber Taylor, Kuo and Sullivan (2002) got parents of girls living in public housing in Chicago to rate the naturalness of their daughters' view from her bedroom window. Higher ratings of naturalness predicted increased ability to concentrate in the young girls. They were also better at inhibiting their impulses and coping with delayed gratification. These findings can be explained through Kaplan's attention restoration theory. The more natural the view from a window, the more fascination it provides. This fascination in turn offers an escape from the real world, allowing for voluntary attention to recover. Following this recovery the girls are able to inhibit distracting stimuli and focus their attention more effectively.

Positive effects of natural spaces on attention have also been found in a population of children with attention deficit disorder (ADD) (Faber Taylor, Kuo & Sullivan, 2001). Parents reported that leisure activities in green environments such as fishing and playing golf led to better attention in their children. One anecdotal account from a parent reported his son 'fishing for hours at a time alone' and that his attention deficit symptoms are minimal following this outdoor activity. Another parent said that their child's attitude towards school work was improved following a week of nice weather which allowed for plenty of time playing outdoors in the park. This is evidence that time spent in nature can noticeably improve attention in a population suffering with a severe attention deficit. Kuo and Faber Taylor (2004) similarly found that activities in green settings increased attention, and decreased hyperactivity, in children with attention deficit hyperactivity disorder (ADHD). This decrease in hyperactivity is not explainable by an exhaustion of energy because activities that exerted very little energy had the same effect. However, this research depended upon parents' reports and perceptions rather than researchers' direct observations. Fortunately, more empirically sound evidence has been found. In line with previous findings by Rothbart and Posner (1985), who implicate the prefrontal cortex in attention control, children with ADD and ADHD have been found to have smaller and less active prefrontal cortices than same aged peers without ADD/ADHD (Casey, Castellanos, Giedd & Marsh, 1997).

In line with White et al (2010) findings that blue environments are preferred over green, and that this includes built blue environments, research into the effect of aquariums has been carried out. The idea is that aquariums are a way of bringing nature, specifically blue environments, indoors. Riddick (1985) was one of the first to find an effect of aquariums. Elderly people, living in specialised care, reported more satisfaction and higher levels of relaxation than those who had the exact same services, minus the aquarium. The subjects in Edwards and Beck's (2002) study were Alzheimers patients living in specialised care units. As a result of their disease their nutritional intake was low, the reasons for this are debated. The introduction of a small aquarium resulted in a significant increase in nutritional intake, as the

patients sat still for longer and did not pace and wander so frequently. They were also more attentive in the presence of aquariums. In accordance with attention restoration theory, aquariums offered a chance for the patients' attention to recover. To most people eating a meal does not require much inhibition of distractions but it is a very different case for those with attention and memory problems.

This is an example of how research into natural environments has been successfully applied with positive psychological, physical and economic outcomes. By increasing nutritional intake through natural means, the patients' quality of life was increased. Furthermore, money was saved, because less nutritional supplements were required for the patients as they were getting their nutrition from the meals that they were now able to sit through.

Kuo et al's (2001, 2004) research provides detailed anecdotal accounts of the benefits of nature on children. These studies suggest that nature can be used as an alternative treatment for children with attention deficit disorders. This is particularly important because of the controversy surrounding medication for these disorders. For example, side effects of the use of stimulants include insomnia, personality changes, unhappiness and nightmares (Efron, Jarman, & Barker, 1997). Nature on the other hand has none of these negative side effects and provides a non-intrusive means of increasing attention and bringing hyperactivity under control. One limitation of this research is that it relied on parents' reports, rather than the researchers own observations.

Bearing in mind previous research which indicates a preference for blue spaces rather than green in adults (Ulrich & Lunden, 1990, Luttick, 2000, White et al, 2010, Lange & Schnaeffer, 2001), it is surprising that the field lacks research into the effects of blue spaces on children. In accordance with current research in to the effects of natural environments on children, perhaps blue spaces will also have a positive effect on their wellbeing.

Aquariums are just one way in which a natural blue environment can be bought inside and made more accessible. This is particularly useful in areas where there is little or no access to blue spaces. Aquariums provide the fascination element of ART. There are bright lights reflected by the water, exotic living creatures, lots of movement and bright attractive colours. They offer an insight in to another world which in turn acts as an escape from daily life. Although they are built environments they are designed in a way that replicates an existing natural environment, but on a smaller scale. Even on a small scale, as with the aquariums used in Edwards and Beck's (2002) study, they provide enough natural features to draw upon involuntary attention and give voluntary attention an opportunity to rest.

The rationale for this study is this: there is very little empirical evidence regarding the effects of blue space on children. What has been shown is that blue environments have a number of positive effects on adults. This is demonstrated through their preference for both built and natural blue environments, over green environments. Given that children show similar preference and affect as adults where green environments are involved it seems reasonable to assume the same holds for blue environments.

In accordance with ART it seems that blue environments offer a superior level of fascination and escape from the everyday. This research will use a much larger aquarium than that used by Edwards and Beck (2002). The Great Barrier Reef exhibit at the National Marine Aquarium, Plymouth, holds 700,000 litres of water and 70 species of fish (Retrieved 16th March 2012 from:http://www.national-aquarium.co.uk/what-you-can-see/blue-planet), making it the second largest tank in the aquarium. Though this environments is built, it is a very natural environment and there is very little else in the room other than seats and a screen which describes each species of fish.

Research so far seems to have overlooked the influence that blue environments have on children's behaviour. It is the aim of this research to address this issue through direct observations. The two main objectives were to observe children's overall behaviour in a blue environment and then to see whether participation in an artistic event enhanced the potential effects of the environment.

In this study, duration of stay at the exhibit and engagement with the exhibit were used as indicators of attention. Observed indicators of arousal, including physical movement were used as a measure of how calm or excited the children were. Mood, either positive negative or neutral, was used to indicate well-being. These were observed during a control week which was representative of a normal week at the National Marine Aquarium and again during the Big Draw week, a special event which encourages visitors to create drawings of the various exhibits.
The following hypotheses have been formed:

Hypothesis 1
The Great Barrier Reef exhibit will have a calming effect on the children across both weeks, in accordance with research showing the calming effects of green space on children and blue space on adults.

Hypothesis 2
The Great Barrier Reef exhibit will have a positive effect on children's mood irrespective of week as a preference for natural environments has been found among children and the exhibit recreates a vast natural environment.

Hypothesis 3
Through drawing the children will be engaged with the exhibit for longer. They are paying more attention to the tank because they want to draw what they see. In accordance with research into green space and how it increases attentional capacity in children it is predicted that the same will be true of blue space. Thus, the children will stay for longer during the Big Draw week.

Hypothesis 4
The children are drawing something which draws upon their involuntary attention, thus it requires little exertion to attend to. Children will be calmer during the Big Draw week.

Hypothesis 5
Children will be happier during the Big Draw week. Children are more engaged with the natural environment as a result of their drawings, which in turn will increase the positive effect on well-being.

Method

Participants
The participants used were members of the general public visiting the 'National Marine Aquarium', in Plymouth. There were 28 males and 44 females. The mean age was eight years old, where the youngest was four and the oldest was twelve.

Materials
During the week of The Big Draw the materials provided to the children were a pencil and a blank-paged drawing book. Clipboards were also available in the room. During the second condition The Big Draw was not running thus no materials were provided. The researchers had an observation sheet per child and a pen to make their recordings. The observation sheet recorded engagement, whether this was social or solitary, arousal and mood on a scale of -2 to +2 and physical movement. There were fifteen columns, one per minute. One stop watch was used between two researchers. The researchers also had a 'Behaviour Key' which gave a brief outline of behaviours (Table 1).

Procedure
The Great Barrier Reef exhibit was the setting for the observations. Prior to the data collection a pilot study was completed by the researchers. This was to ensure that they fully understood the method of data collection and the behavioural definitions. As a result of this pilot study the behaviour key was created, so that both researchers were looking for the same behaviours. The observation sheet was also made larger to make it clearer for the researchers when making note of their observations. The setting where the observations took place was the Great Barrier Reef exhibit which holds over 70 species of exotic fish. A4 copies of the brief were displayed at the ticketing desk. A3 copies were attached to the wall of the entrance and exit to the Great Barrier Reef exhibit. This explained the nature of the observations and detailed the procedure should anyone wish for the child in their care not to take part. The researchers sat at the back of the room on tiered seating.

Once a child and their guardian had walked past the brief the researchers decided upon one child that they would both observe, for a period of up to fifteen minutes. During the Big Draw condition children were only selected who were holding drawing materials. The researchers assigned them a participant number and recorded their gender, approximate age, and the time and date on the observation sheet. The stopwatch was then started and the following observations were written down: Were they engaged in the tank? Regardless of engagement with the tank, were they engaged socially or solitary? How aroused were they (-2 to 2)? What was their mood (-2 to 2)? Were they stationary (stood still, sat or laying down), walking (including skipping) or running? And were they drawing, not drawing or taking a photograph?

Table 1: Behaviour key

Behaviour	Indicators
Engaged	Gaze/focus directed towards tank. Reaching, talking to or touching the tank.
Social Engagement	Interaction with other individuals. Both verbal and physical behaviour.
Arousal	General energy, activity and excitement. -2: Sat down/lying down, unmoving, slow. -1: Still, unenergetic, calm, slow moving. 0: Peaceful, expressionless, blank. +1: Positive, kinetic, engaging or climbing, talking, making noises. +1: Hyper, loud, running, excited. Big movements, lots of noise.
Mood	Through facial expressions, speech, noises, gestures and movements. -2: Visibly upset, tantrums, crying, strops, distress. -1: sad, indicated by facial expressions, whinging. 0: Neither sad, nor happy, little/no noises. Blank expressions. +1: Good mood, surprised noises in response to fish. +2: Extremely happy, loud noises, flapping.
Physical Movement	Stationary (stood still, sat, laying), walking (or skipping), running.

Note: In SPSS the following codes were applied. Engaged: No 0, Yes 1, Socially Engaged: No 0, Yes 1, Arousal: -2 to +2, Mood: -2 to +2, Physical Movement: Stationary 1, Walking 2, Running 3.

These were recorded every minute for up to fifteen minutes, or until the child left the room. The independent variable was whether or not ‘The Big Draw’ event was taking place. The dependent variables were the observations made regarding engagement, mood, arousal and physical movement. The data collection was strictly observational thus there was no direct interaction with the children.

Results

The data collected was coded into numbers so it could be entered in to SPSS. If the child was observed to be engaged this was represented by a 1, if they were not this was represented by a 0. Similarly for social engagement, yes became 1 and no became 0. Arousal and mood remained on a -2 to +2 scale. For physical movement, stationary was coded as 1, walking as 2 and running as 3.

Preliminary Analysis

The descriptive statistics (Table 2) indicate differences between the 'Big Draw' and control week, across all observation categories.

Table 2: Mean observations for the Big Draw week and the control week

	Big Draw (Mean, S.D.)	Control (Mean, S.D.)
Number of Observations	6.17 (3.79)	4.11 (3.87)
Engagement	.84 (.24)	.79 (.36)
Social Engagement	.61 (.29)	.71 (.34)
Arousal	-.06 (.61)	.46 (.60)
Mood	.52 (.46)	.37 (.65)
Physical Movement	1.24 (.26)	1.35 (.40)

Children stayed for longer (number of observations) during the Big Draw week than during the control week. Furthermore, during their stay they were more engaged with the exhibit and less socially engaged during the Big Draw week, in comparison to the control week. For the purpose of this research low arousal indicates calmness, thus the children were calmer during the Big Draw week than they were during the control week. Their mood was also more positive during the Big Draw week. There is also a small difference in physical movement where during the Big Draw children were less physically active, which the researchers interpreted to be a further indicator of calmness. Although the descriptive statistics indicate where differences in effect may lie it does not indicate significance, which tells us whether or not the differences are down to chance.

A Shapiro-Wilke's test of normal distribution shows that age is normally distributed across week one (p=.09) and week two (p=.05). Gender was not normally distributed (both weeks p=<.001). Levene's test of normal distribution shows that number of observations (p=.48), social engagement (.76), arousal (.98) and mood (.59) have equal variance. Engagement (.004) and physical movement (.017) do not, thus should be interpreted with caution.

Cohen's Kappa found moderate interrater reliability between all observers (k=.51, p=<.001). Where 0-.20 is slight, .21-.40 is weak, .41-.60 I moderate 61-80 is substantial and .81-1 is almost perfect (Landis & Koch, 1977). There was only a slight difference in inter-rater reliability between researcher one with researcher two (Big Draw week) k=.52, p=<.001, and researcher one with researcher three (control week) k=.48, (p=<.001). When the file was split by measure the following were found: engagement k=.70, (p=<.001), social engagement k=.55, (p=<.001), arousal k=.25, (p=<.001), mood k=.28, (p=<.001) and physical movement k=.52, (p=<.001). Engagement measures had substantial reliability, social and physical movement measures had moderate reliability and arousal and mood had weak reliability. Results need to be interpreted carefully because the second and third observers did not always make the same observations as the first observer.

Main Analysis
A series of 2x2 (Week x Gender) repeated-measure analysis of variance (ANOVAs) were carried out on each of the dependant variables separately. These explored the effect of both week and gender upon the dependent variables separately, and then checked for an interaction. There was a significant effect between week and how long the children stayed Ms= 6.03 versus 4.03, F(1,68)= 4.64, p= <.05. During the Big Draw children stayed for longer. There were no gender or interaction effects; all children stayed longer. Children were also calmer during the Big Draw week compared to the control week. Ms= -.04 versus.46 F(1,68)= 4.64, p = <.001. Again there was no effect of gender or an interaction effect, all children were calmer. There were no effects of week or gender on mood (p=.26 (week), p=.06 (gender)), social engagement (p=.17, p=.28), or physical activity (p=.17, p=.60). Gender was not found to have an effect on any of the dependent variables. Thus it cannot explain the relationships found.

It is evident that week had an effect on the children's behaviour but age may have an effect on this relationship. When age was added to the model as a covariate both findings remained significant; children stayed longer during the Big Draw Ms=6.02 versus 4.05 F(1,68)= 4.64, p=<.05. Children were calmer during the Big Draw Ms=-.03 versus .45 F(1,68)= 4.64, p=.002. This means that the results found were not due to age differences, or gender differences.

A two-tail pairwise correlation was carried out on the data to identify relationships in the data set. Pearson's correlation found that across the two weeks the longer children stayed, the less aroused they were, r(72)= -.42, p <.001, two tailed, indicating an overall calming effect of the Great Barrier Reef exhibit at the aquarium. A longer stay also correlated with less social engagement, r(72)=-.25 p=<.05, two tailed, and less physical activity -.27. p=<.05, two tailed, Furthermore, the more engaged in the tank that they were the happier they were, r(72)=.45 <.001, two tailed. This shows that being engaged with the exhibit has a positive effect on mood.
To see the relationships for both weeks separately a split file code was used then the analysis was re-run. For both weeks the more engaged the children were the happier their mood. For the week of the Big Draw the correlation was r(72)=.43, p=<.05, two tailed, for the control week the correlation was r(72)=.46, p=<.05, two tailed. This supports that the exhibit has a positive effect on mood regardless of week. Both conditions, when split, found social engagement correlates with less physical movement; r(72)= .37, p=<.05, two tailed, for the Big Draw week and r(72)= .38, p=<.05, two tailed, for the control week. For the Big Draw week, but not for the control week, the longer the children stayed the calmer (less aroused) they were. This suggests there was something about the Big Draw week that made the children more relaxed that was missing in the control week.

Discussion
The setting of the study alone provides support for the Biophilia hypothesis (Wilson, 1984) in general, and the benefits of blue space on wellbeing specifically. Visitors have to pay in order to enter the aquarium, supporting previous findings that people are happy to part with their money so that they can reap the benefits of blue space (Luttick, 2000, Lange & Schnaeffer, 2001, Arin & Kramer, 2002). Having said this, it may be more indicative of adults' preference for blue space as they are typically the

ones paying. On the other hand, they probably would not pay to take the children in the first place if they did not think that they would enjoy the experience. The current findings indicate that children do enjoy visiting the aquarium.

Summary of Findings

The present study provides some evidence of a positive effect of blue spaces on children's behaviour. This suggests that findings from natural green environments (Kuo et al, 2001, 2002, 2004) may be generalisable to blue spaces. It was predicted that there would be an overall calming effect of the aquarium across both weeks, as well as a positive effect on mood. The results support these predictions; the longer the children stayed at the exhibit the calmer they were. Furthermore, the more engaged with the exhibit that they were, the happier they were. These findings go some way towards addressing the gap in the literature regarding the effects of blue space on children.

The research also investigated whether the Big Draw could enhance the positive effects. The results from the Big Draw week suggest that there was something about the event which enhanced the calming effects. During the Big Draw the children stayed for longer, which in turn led to calmer behaviour. However, there is no indication that children were happier during the week of the Big Draw. The children showed roughly equal levels of happiness across both weeks. The fact that the children stayed for longer is very important because it indicates that the children were enjoying the exhibit more and perhaps getting more out of it when the Big Draw event was taking place.

Interpretation of Findings

The findings lend further support to the co-occurrence of cognitive and emotional restoration, as was found in van den Berg et al (2003) study. The increase in calmness and positive mood support Ulrich's idea that natural environments restore people's emotions. Whereas, during the Big Draw week children stayed for longer which supports Kaplan's idea that natural environments restore people's attentional abilities; the children were able to pay attention to a task which required directed attention.

The findings presented so far are in accordance with Kaplan's (1995) ART theory. There are many fascinating elements of the Great Barrier Reef exhibit. Firstly, the tank is made up of many species of brightly coloured and unusual looking fish. It is also lit in a way that enhances these natural colours. The life, colours and movement within the tank provide an environment very different to those experienced in our everyday lives, providing an escape. The tank also reflects the biodiversity of the real Great Barrier Reef, offering a huge variety of things for the children to look at which makes the extent of the exhibit much greater. Extent is another element of ART which can make an environment more restorative. According to Kaplan environments such as this effortlessly draw upon our involuntary attention, which seems to be evident in the results of this study.

Natural environments have been found to enhance the attentional capacity and promote calmness in previous studies with children (Kuo et al, 2001, 2002, 2004). By giving the children an activity which encourages them to explore the environment in more depth, in this case drawing, the positive effects of the environment seem to be

enhanced. It remains uncertain whether it is having an activity to focus attention on in general, or whether it is something specific to drawing, which is responsible for the enhanced effects. The anecdotal account from a parent in Faber Taylor, Kuo and Sullivan's (2001) research - which reported a child with ADD who spent hours fishing, despite his attentional capacity being very limited in day to day life - suggests that it may not be unique to the activity of drawing. There seems to be an interaction between having a purpose to focus attention and stay longer, drawing or catching a fish for example, and the natural environment making very few demands on voluntary attention.

A further finding from the current research was that a longer stay correlated with less social engagement. This supports Staats and Hartig (2004) who found that it is not the social aspects of being in natural environments that are restorative, it is the natural elements themselves, which is what Kaplan (1995) and Ulrich (1983) argued. Findings from this study suggest that social engagement may even be a hindrance to the restorative properties of natural environments. The most common social interaction in the current study was between a child and the adult whose care they were in. It is also worth mentioning that the Great Barrier Reef Exhibit, which was the location of the observations, was also the last exhibit before the exit. Thus, many social interactions involved the parent hurrying the child along so that they could leave. This factor was not accounted for when the researchers were making their observations so potentially acted as a confounding variable, making some children leave sooner than they would have liked.

At this point it is important to remind ourselves that these results ought to be interpreted cautiously. The interrater reliability between the three different observers was unfortunately not as strong as the researcher would have liked, thus there were discrepancies between the observations each observer made. Having said this there were no differences between observers in terms of how long they observed each child for, so any findings regarding the length of stay of the children is reliable. Furthermore, there was substantial interrater reliability regarding whether or not the children were engaged in the tank and moderate reliability for measures of social engagement so again findings regarding these measures can be seen to be suitably accurate. It did not come as much of a surprise to the researcher that interrater reliability for arousal and mood was relatively weak. These are the most subjective measures used in the observations. Despite the observers' best efforts to make a strict behaviour key, following the pilot study, it is evident that this key needs refining should a similar study be carried out again. There was some ambiguity regarding indicators of arousal and mood and this is partly down to the lack of observational research in this area. Another methodological flaw which is partially accountable for the low interrater reliability in this study is the way in which the observations were made. At the start of every minute each measure was recorded on the observation sheet. However, over the course of a minute behaviours inevitably vary, for example the child may have been calm when one researcher made their observation but if the second researcher made their observation several seconds later then their arousal levels may have gone up. This is by no means accountable for all of the variability, but a stricter procedure for recordings may have been beneficial and should be used should future research take place. Despite this the results are still very promising. Though they must be interpreted cautiously, there is evidence of positive effects of aquariums visits on children's behaviour.

Limitations and Future Research

The setting used for the observation was the very last exhibit in the National Marine Aquarium. Though a significant increase in duration of stay and calmness during the Big Draw week was found, it is worth considering that these effects may differ at earlier exhibits. It is unclear if the findings from this tank are down to a specific feature of the Great Barrier Reef exhibit, for example the brightly coloured fish, or the presence of a turtle, or whether they are representative of a general effect of the Big Draw event itself. There is reason to believe, following previous research (Kuo et al, 2001, 2004) that it is the activity that is responsible for the increased effects but it may be of interest to carry out similar observations throughout the different exhibits at the aquarium. It is also worth considering that the children may have become fatigued by the final exhibit, having done many drawings throughout their visit, before they reach the exhibit where the current observations were made.

Though the evidence from this research is promising, it is not something that, to the researchers' knowledge, has been explored before. With this in mind the following are ways in which this research could be expanded upon in order to build a stronger case for the findings. Firstly, the population used here were children visiting Plymouth's National Marine Aquarium across the course of two separate weeks. This sample may not be representative of the general population of children. Plymouth is a coastal city, thus the children living in and around Plymouth are likely to have more exposure to blue spaces than say children from Birmingham and its surrounding areas. Perhaps research carried out at Birmingham's Sea Life Centre may yield different results. Furthermore, as previously mentioned, there is an admittance fee to enter the National Marine Aquarium which limits the population to those people who can afford to pay to visit. Perhaps children from families with a lower income would behave differently; this could be explored on a smaller scale through the use of aquariums set up in school environments.

The current study does not make a distinction between the effects of the blue space, essentially the water component of the tank, and the living elements like the fish and turtle. It is undoubtedly important when offering ART as an explanation of the result because they make up much of the fascination elements of the exhibit. However, this is not to say that there is not a positive effect on children of a tank made up of just corals, which are still living creatures but do not offer the same sense of life as the fish and turtles, because they do not move around and interact with one another. It may be beneficial for future research to investigate the effect of blue spaces that lack the biodiversity of the Great Barrier Reef Exhibit. Using ART it is predicted that without the living elements the positive effects on happiness and calmness found in the present research would be much weaker, or possibly not present.

Implications

Despite the weaknesses that have been addressed it is important not to lose sight of the significance of the findings from this research. They go some way to addressing the gap in current research and indicate that blue space in general, and aquariums in particular, do have a positive effect on children's behaviour and wellbeing. Furthermore, the Big Draw event enhanced these effects and led to a significantly longer stay at the exhibit, thus presumably in the aquarium as a whole. The findings

also offer a foundation for future research, which is undeniably needed to make a strong empirical case for the findings so far.

Wills and Evans (2009) research found that living in rural environments can act as a moderator of stressful life events for children. With this in mind the current findings may have an important application for inner city children, who may not have much exposure to natural environments. As previously mentioned, aquariums are an effective way of bringing nature in doors, thus making it more accessible for people who may not be able to get out into natural environments very easily. By creating more inner city aquariums, the positive effects experienced at the National Marine Aquarium could be benefitted by a wider population. Furthermore, by introducing small aquariums into everyday settings such as waiting rooms and restaurants more children, and adults, will be able to experience their positive effects on mood and calmness.

The findings could also be applied to educational settings. Introducing aquariums into classrooms and play settings within educational environments, may enhance the children's' sense of wellbeing. When considering this research alongside Edwards and Beck's (2002) research, in the context of ART, it is likely that the children will be able to pay attention for longer in the presence of an aquarium. This in turn could be very beneficial for their learning. Taking this one step further it could be an excellent way to teach the children by directly incorporating the aquarium into lessons, such as science and art.

Parents of children with attention deficits, such as those in Kuo et al (2001, 2004) research may also benefit from these findings. Though this study used a sample of children from the general population there is reason to believe that children with ADD/ADHD may also feel calmer and more able to pay attention following interactions with an aquarium; as with the elderly patients in Edwards and Beck's (2002) research. According to Ulrich (1983) those whose attentional capacity is easily fatigued are most likely to benefit from the restorative potential of natural environments. Perhaps incorporating a small fish tank into the home may also provide a non-intrusive method of treatment for some of the symptoms. Having said this, the current research would need to be carried out on a sample from this population in order to support this idea.

Conclusions

The present study has very promising findings for the overall positive effects of aquarium visits, as well as the benefits of hosting events such as the Big Draw, in order to maximise these positive effects. Further studies are needed in order to consolidate and expand the present findings but it offers an insight in to how blue spaces may influence children's behaviour, something that to date seems to have been overlooked. The findings have potential implications for educationalists, parents and healthcare professionals, amongst others, who may be able to incorporate aquarium visits or build aquatic environments into settings where children spend a lot of time. Finally, if children's appreciation and enjoyment of aquarium visits can be enhanced, the National Marine Aquarium may be able to use this support their education and promotion of conservation attitudes. It is of the utmost importance that people's evident love of nature is recognised before too much more irreversible

damage is done to the world's natural environments, which seem to benefit our psychological wellbeing so much.

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