



# Understanding community perceptions of an urban stream before and after a discussion of revitalization possibilities using photo-elicitation

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## Abstract

Understanding local community perceptions is an important first step in seeking ways to revitalize degraded urban streams. This research sought to understand community perceptions of the highly modified Parnamirim stream in the city of Recife, Brazil and to solicit perspectives on potential for revitalization of the stream before and after discussion of such possibilities using a photo-elicitation-based approach. Structured interviews were conducted with 167 residents situated close to the stream using three photographs of urban streams in various stages of modification and revitalization to prompt responses regarding preferences and opportunities for stream revitalization. While a majority of respondents overall indicated that the Parnamirim stream currently looks like a degraded stream (as depicted in one photograph), these perceptions generally matched the characteristics of the stream in their particular area of residence, indicating that people's perceptions are influenced by the quality of their immediate environment. However, after the brief discussion of urban stream revitalization practices, there was overall positive response for Parnamirim stream to become like the photograph of the revitalized stream shown to participants. Our findings point to the power and utility of the photo-elicitation method in terms of provoking emotional and cognitive responses to local environmental conditions and in promoting changed community perceptions of possible Parnamirim stream revitalization and its future potential. The potential for social desirability bias to influence community perceptions is acknowledged regarding the post-discussion preferences and comments regarding the potential for revitalization of Parnamirim stream. Nevertheless, the research demonstrates the value of engagement in discussion and ideas sharing with community members through the use of photo-elicitation and such approaches may represent an important first step in realizing urban stream revitalization.

**Keywords** Public perception · Photo-elicitation · Urban streams · Restoration · Revitalization

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## 1 Introduction

There is a long tradition of research emphasizing the importance of understanding people's perceptions of natural features (e.g. Tunstall et al. 2000; Carmona et al. 2002; Winz et al. 2011; Yocom 2014; Cettner et al. 2012; Abraham et al. 2016; Smith et al. 2016). Many of these studies consider urban streams in this context which is the focus of this paper. Lee et al. (2014) note that environmental cues are an important component of measuring environmentally friendly urban development, as well in generating positive feelings, behaviour and eventual support for natural features. Similarly, Smith et al. (2016) affirm that urban stream restoration projects have benefited from incorporating societal outcomes. Understanding people's perceptions is thus an important first step in a strategy for sustainable recovery or revitalization of degraded urban streams and other natural features.

Streams and rivers, as the low-lying points of the landscape, are especially sensitive to and profoundly impacted by the changes associated with urbanization and suburbanization of catchments (Bernhardt and Palmer 2007), especially through activities like sewage disposal and accumulation of discarded solid waste. Urbanization of catchments leads to changes of streams in three main ways: (1) geomorphic simplification in that habitat heterogeneity and floodplain connectivity are reduced; (2) diminished societal value in that stream channels become increasingly unattractive and are avoided for recreational purposes; and (3) ecological simplification in that stream biodiversity declines and stream ecosystem functioning is impaired (Bernhardt and Palmer 2007). These changes can result, for example, in a reduced capacity of streams to remove or balance nutrient levels, leading to problems such as excessive algal blooms. Revitalization efforts seek to return degraded urban streams to a more natural state, and therefore seek to recover ecological, social and hydrological functions of streams (Buchholz and Younos 2007). Stream revitalization can thus improve both the functionality of streams and the quality of life of urban dwellers (Stahre 2008).

It has been observed that traditionally, urbanization increases pressure on urban water resources, including streams commonly being used for sewage transport (Winz et al. 2011; Smith et al. 2016) amongst other alterations. However, this view of urban streams is not the only vision available for contemporary community leaders. Buchholz and Younos (2007) note that trends in environmental awareness and stewardship are gaining momentum. It is thus possible to build a more holistic future for urban streams. A sustainability-oriented approach to urban stream management attempts to address problems of flooding, erosion and water quality holistically and strategically using a multi-disciplinary approach to urban water management that integrates social and physical sciences (Cettner et al. 2012; Winz et al. 2011; Wong and Brown 2009). Sustainable management of urban streams should return the streams that often become buried in pipes or closed over by other structures back to the surface environment (Stahre 2008) and re-establish earthen banks in a more natural state where streams have been channelized (Asakawa et al. 2004; Bernhardt and Palmer 2007; Thompson and Parkinson 2011) as well as removing or controlling polluting in-flows such as sewage.

With respect to processes for initiating a shift to sustainable management of urban streams, Keys et al. (2016) argue that it is essential to provide the public with the means to reflect on environmental issues through continuous and integrated actions, promoted by various sectors of society. This means that having the support of the community for revitalization projects is important (Beaumont 1997; Lee et al. 2014; Buchholz and Younos 2007; Smith et al. 2016). The way in which the community values urban streams plays a

significant role in determining the motivation to act and the type of action taken (Thomson and Pepperdine 2003). For example, Smith et al. (2016) emphasize that large-scale socio-political movements aimed at restoring streams are generated by groups of people having the perspective that improving ecosystem structure and function has ecological and societal value. Thus, to support future urban stream revitalization it is necessary to understand community perceptions in relation to the urban stream.

The purpose of this study was to understand the perceptions of local residents regarding a urban stream within the city of Recife in Brazil. More specifically the research sought to compare perceptions of people from different urban areas in regard to their local waterway, the Parnamirim stream, which has been highly modified in places. The research also solicited perspectives on the potential for revitalization of the stream before and after discussion of revitalization possibilities using an approach based on photo-elicitation.

The use of photo-elicitation in qualitative research evokes personal connection including triggering information, narratives, feelings or memories through engagement with a photograph related to the subject of investigation (Harper 2002; Hurworth 2003; Flick 2009). It is a useful method for understanding people's perceptions of place, including natural values and heritage (Ireland and Ellis 2005; Beckley et al. 2007; Tonge et al. 2013; Hood and Reid 2018). Harper (2002) points out that the photo-elicitation technique enlarges the possibilities of conventional empirical research using surveys or interviews. We adopted the approach of showing specific pre-selected images to all participants during interviews, following the example of Harper (2002) and Hood and Reid (2018); the alternative approach being to have study participants provide and share their own photographs with the researcher (e.g. Flick 2009; Beckley et al. 2007; Tonge et al. 2013).

## 2 Methodology

### 2.1 Characteristics of the study area

The Parnamirim stream is located in the Northwestern Zone of the city of Recife, Pernambuco state, Brazil, and is a tributary of the Capibaribe River. It is 1.3 km long, approximately 1.5 m wide and has a catchment area of 153 ha over 12 ha of which are permeable (Braga et al. 2009). As demonstrated by Photograph 1, sections of the stream have been modified through canalization and there are water pollution issues arising from domestic refuse and also sewage entering the stream.

The urban form of the study zone varies considerably. Five areas were distinguished in relation to a combination of the characteristics of the Parnamirim stream in each area and the type of housing occupied by residents (Table 1). The location of the five areas is shown in Fig. 1. Parnamirim stream is covered over in Area 2, but can be seen as a blue line in Fig. 1 crossing from the top left of Area 3 diagonally downwards through Area 5, into Area 1 then turning sharply above Area 4. Photograph 1 corresponds to the site in the upper middle zone of Area 1 where Parnamirim stream undergoes this sharp turn. In this research, we did not solicit socio-economic or other demographic information from participants, but rather surmise broad differences in socio-economic status based upon the characteristics of housing stock and urban form in each area, supported by local census information. A brief description of the five areas follows.

Area 1 is characterized mostly by high apartment towers, and residents may be considered comparatively wealthy (Municipality of Recife 2012). A subset of this area of social

**Table 1** Groups of interviewed according with different parts of the urban stream

Sample group	Stream	Buildings of residents
Area 1—Shopping Plaza and McDonald's (52 respondents)	Stream is visible between roads, and it is rectified and channelled	Dominated by apartment towers
Area 2—Jeronimo de Albuquerque (52 respondents)	Stream is not visible; being covered over by streets, houses and tower blocks	Dominated by apartment towers
Area 3—Samuel Lins (19 respondents)	Stream is visible in a square and behind high walls of houses and towers, and it is in process of rectification and channelling	Some apartment towers, but mainly houses
Area 4—Community Vila Viniém (17 respondents)	Stream is visible between roads, and it is rectified and channelled	Low-income dwellings
Area 5—Community Lemos Torres (27 respondents)	Stream is not visible; being covered over or obscured by low-income dwellings built in or over the stream bed itself	Dense low-income dwellings





small public square as well as between high walls of houses and towers, and it is in process of rectification and channelling. A subset of this part of the city (Area 5) is characterized by low-income dwellings (known as Community Lemos Torres) occupying several streets. Within Area 5 dwellings have been built on the stream bed and banks to the extent that the stream is completely covered. In summary, Areas 1, 2 and 3 are comparatively wealthy with people living in apartments and houses; areas 4 and 5 are comparatively low income.

According to the census of the low income areas of Recife (Municipality of Recife 2012; Fundaj 2001; Braga et al. 2009) the population of Community Lemos Torres (Area 5) in 2001 was 840 people (190 residences). The area around Parnamirim stream was once a large floodplain that was occupied for urban use gradually during the early to mid 1950s, being an attractive destination, due to its location which was close to businesses and source of employment opportunities. Increasing urban development narrowed the stream, replacing banks with the walls of buildings and in some places through landfilling activity, and with sewage discharge into Parnamirim stream. The altered hydraulic capacity and environmental quality of the stream causes discomfort to the population due to the stench, also the proliferation of insects and rodents at the site, which is compounded by the dumping of trash by the nearby residing population and visitors using the area.

## 2.2 Interviews using photo-elicitation

Citizens of Recife living in proximity to the Parnamirim stream were surveyed using face-to-face structured interviews based on photo-elicitation. The structured interviews comprised six questions (Table 2) and accompanying photos (Fig. 2) shown to interviewees in relation to three of these questions. The three photographs (Fig. 2) shown to interviewees depicted: (1) a section of the Parnamirim stream (within Area 1 of Fig. 1) that has been highly modified through canalization with concrete walls; (2) a section of the Jordão river within another neighbourhood of Recife (some 20 km away from the study area) that had recently been modified by the municipal government (i.e. to remove slum housing within the floodway zone, and establish concrete channel walls topped with a grass strip); and (3) a stream in England that has been revitalized with provision of more natural features (rocks and revegetated soil banks) along with benches and pedestrian access.

## 2.3 Sampling and interview process

A stratified sampling approach across the five different areas of the Parnamirim stream study zone was undertaken to enable any differences in perspectives of residents in each of the five areas to be determined. A form letter explaining the research was distributed to every dwelling in the overall study area. One week later, all dwellings were

**Table 2** Interview questions

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- (1) Which model of the stream do you prefer (Photograph 1, 2 or 3)?
  - (2) The Parnamirim stream looks more like which stream (Photograph 1, 2 or 3)?
  - (3) What are the main problems of the Parnamirim Stream?
  - (4) What does revitalizing a stream mean?
  - (5) Is it possible for the Parnamirim Stream to become like the revitalized stream shown in Photograph 3?
  - (6) [If yes to Q5] What needs to be done to make this happen?
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**Fig. 2** Photographs shown to interviewees



Photograph 1 – Parnamirim stream (Source: lead author)



Photograph 2 – Jordão river (Source: lead author)



Photograph 3 – Stream in England (Source: Janes, 2011)

visited to request an interview. Once approximately 10% of residents within a given street or apartment block had participated in an interview, the researchers moved to a new location and repeated the process. Interviews were conducted in Portuguese by the lead author.

The interview was conducted in three parts. First, respondents were asked to respond to Questions 1 to 3 (Table 2) which recorded aesthetic preferences for urban streams using the three photographs as well as perceptions of current problems with the Parnamirim stream. The interviewer showed the three photographs (A4 size: 210×297 mm) at the same time (e.g. fanned out on a table), so the respondents could compare and choose between them for questions 1 and 2. Second, the interviewer then provided a brief explanation of urban stream revitalization, using as a model the image shown in Photograph 3. Using an image was deemed an effective means of communicating what otherwise would come across as specialized technical information regarding urban stream revitalization practices (e.g. such as channelization, retaining walls, set-backs, flood control, stream meanders and so on) (Hood and Reid 2018; Hurworth 2003). Participants were briefed on some revitalization practices in this discussion. For example, it was explained that when there is need to put retaining walls near streams, it is desirable to build them away from the main channel of the stream, so as to enable the preservation or return of meanders and for the margin of the stream to be extended. Another point discussed was the creation of recreational areas along stream banks, which may also contribute to maintaining the creek with its natural soil, free of trash and sewage releases. Question 4 was then posed, asking respondents to explain what stream revitalization means to them. Third, the interviewer then proceeded to Question 5 seeking an indication of perceived potential to revitalize the Parnamirim stream in a manner similar with Photograph 3. This image was used as it most closely visually represented the notion of sustainable urban stream management based on the literature. Question 6 was only posed to those who answered positively to Question 5, and was intended to solicit ideas for how revitalization of the Parnamirim stream might best be accomplished from the perspective of local citizens. The purpose of the discussion regarding stream revitalization processes in the second part of the interview was to enable perceptions to be obtained before the discussion (Question 1, 2 and 3) and after the discussion (Questions 5 and 6). Analysis of results obtained for the six interview questions is based on frequency of response, and chi-square analysis.

### 3 Results

A total of 167 individual residents participated in an interview. Results obtained for each of the six interview survey questions are presented and discussed in turn. Not all of the 167 interviewees answered all of the questions (as indicated in the summary tables of results). The small number of non-responses along with other answers receiving small response rates (1–2%) was excluded from subsequent analysis.



### 3.1 Urban stream preference

In response to Question 1 and on being shown the three photographs of urban streams, there was a strong preference for the more natural looking riparian options (Table 3). While the revitalized stream attracted the largest proportion of responses (50%), interviewees were roughly divided between this and a preference of the channelized stream (46%) as the best model for an urban stream.

While residents in all five areas indicated a preference for the channelized stream option, a statistically significant association was evident (Table 4). Residents of Area 5 indicated a stronger preference for Photograph 2 over 3 (Fig. 2), while Area 1 residents favoured 3 over 2. Before interpreting these findings, it is useful to also consider the results obtained for Question 2.

### 3.2 Perceptions of the Parnamirim stream

When asked to indicate which of the three photographs the Parnamirim stream looks like, the majority (56%) responded that it looks like Photograph 1 (i.e. degraded stream), followed by 32% of respondents answering that it looks like Photograph 2 (Table 5).

Statistically significant differences between the five areas were also evident regarding responses to Question 2 (Table 6). Notwithstanding the overall dominance of Photograph 1 in response to this question (which is especially the case for respondents from Area 5) that most interviewees (74%) had a perception that the Parnamirim stream looks like Photograph 1, residents in Area 4 (71%) were more likely to suggest that the Parnamirim stream looks like Photograph 2, along with a sizeable portion of Area 1 respondents (43%),

**Table 3** Which model of the stream do you prefer (photograph 1, 2 or 3)?

Photograph 3 (English stream—revitalized with soil banks and social access)	84 (50%)
Photograph 2 (Jordão River—concrete and grass bank)	77 (46%)
Photograph 1 (Parnamirim Creek looks like sewer)	3 (2%)
Total	164 (98%)

**Table 4** Stream preference across the five areas ( $\chi^2 = 20.31$ ,  $df = 8$ ,  $p < 0.01$ )

	Area 1	Area 2	Area 3	Area 4	Area 5	Total
Photograph 3	36 (69%)	28 (55%)	8 (44%)	6 (35%)	6 (23%)	84 (50%)
Photograph 2	16 (31%)	21 (41%)	10 (56%)	11 (65%)	19 (73%)	77 (46%)
Photograph 1	0	2 (4%)	0	0	1 (4%)	3 (2%)
Total	52 (31%)	51 (31%)	18 (12%)	17 (10%)	26 (16%)	164 (98%)

**Table 5** The Parnamirim stream looks more like which stream (Photograph 1, 2 or 3)?

Photograph 1 (Parnamirim Creek—highly modified and degraded condition)	94 (56%)
Photograph 2 (Jordão River—concrete and grass bank)	53 (32%)
Photograph 3 (English stream—restored)	12 (7%)
Total	159 (95%)

**Table 6** Perceptions of the Parnamirim stream across the five areas ( $\chi^2=22.441$ ,  $df=8$ ,  $p<0.01$ )

	Area 1	Area 2	Area 3	Area 4	Area 5	Total
Photograph 1	25 (51%)	36 (72%)	9 (56%)	4 (23%)	20 (74%)	94 (56%)
Photograph 2	21 (43%)	10 (20%)	4 (25%)	12 (71%)	6 (22%)	53 (32%)
Photograph 3	3 (6%)	4 (8%)	3 (19%)	1 (6%)	1 (4%)	12 (7%)
Total	49 (29%)	50 (30%)	16 (9%)	17 (10%)	27 (17%)	159 (95%)

relative to respondents from the other areas. These findings accord with the actual condition of the Parnamirim stream in the vicinity of these areas as per the descriptions provided previously regarding degree of channelization and other stream characteristics. Thus, respondents generally selected the photograph that approximated the appearance of the stream in their specific vicinity.

The response to Question 1 (Table 4) can be better understood in this context. In particular there is clear preference by residents for enhanced or revitalized forms of the Parnamirim stream to be realized relative to its current condition with respondents from Area 5 having preference for the channelized form (Photograph 2) and those from Area 1 preferring the more natural form of Photograph 3.

In response to Question 3 regarding the main problems with Parnamirim stream, the most common singular answer from 61 respondents (37%) was flooding (Table 7). Here, a variety of reasons for the flooding were offered by respondents including being the consequence of garbage and sewage disposal into the stream, channelling and narrowing of the stream and removal of riparian vegetation. Some respondents indicated a combination of all or some of these reasons and some simply stated that flooding was the problem without providing explanation of the causes. A similar proportion of respondents (34%) placed blame on misuse of the stream by the population and government neglect. Other responses such as the discharge of waste into the stream and health risks (6% each) or odour problems (5%) are inter-related as these are exacerbated during flooding events and are the consequence of resident behaviours towards the stream. There were no statistically significant differences in responses across the five urban areas in the study.

### 3.3 Perspectives on stream revitalization

When asked to indicate what revitalizing a stream means to them (Question 4), the most frequent response offered by 71 interviewees (42%) was to make it more natural, while

**Table 7** What are the main problems of the Parnamirim stream?

(i) Flooding (because of a combination of garbage, sewage, channelling/narrowing of stream and riparian vegetation removal)	61 (37%)
(ii) Misuse of the population/neglect of the government	57 (34%)
(iii) Waste/sewer	16 (10%)
(iv) Health risks	10 (6%)
(v) Olfactory and visual disturbance	10 (6%)
(vi) Don't see problems or don't know	9 (5%)
Total	163 (98%)

**Table 8** Response to: what does revitalizing a stream mean?

Making it more natural	71 (42%)
Making it aesthetically better	39 (23%)
Cleaning, dredging and canalization	32 (19%)
Remove trash and sewer	6 (4%)
Cleaning and education of the population	6 (4%)
Don't know	13 (8%)
Total	167 (100%)

**Table 9** Possibility for revitalization of Parnamirim stream to become like the revitalized stream shown in Photograph 3

Yes	113 (67%)
No	36 (22%)
Unable to judge	18 (11%)
Total	167 (100%)

a further 39 interviewees (23%) suggested making it aesthetically better. However, 32 interviewees (19%) believed that revitalizing a stream means cleaning, dredging and canalization (Table 8). Given that at this stage of the interview, respondents had been shown the three photographs, and that half had selected the more natural looking stream in response to Question 1 (preferred stream), it could be expected that they were primed to respond in this manner to a certain extent. There were no statistically significant differences in responses across the five urban form areas in the study.

Following the brief discussion of urban stream revitalization practices conducted with each interviewee using photograph 3 to explain the benefits of the more holistic urban stream revitalization, Question 5 asked residents whether it would be possible to revitalize the Parnamirim Stream in a similar fashion. There was an overall positive response (Table 9) with 113 respondents (67%) saying yes. Where previously almost half of the respondents to the first interview survey question had indicated a preference for a channelized stream (46%), following the discussion regarding urban stream revitalization there was much greater support for the kind of measures depicted in Photograph 3 (i.e. up from the initial 50% of respondents who preferred the stream depicted in this photograph in response to the first interview question). On the one hand, it could be expected that the interviewer's discussion of the topic biased the responses received (a point to which we return in Sect. 4 regarding potential social desirability bias). It is interesting though that 36 respondents (22%) stated that they did not believe it is possible to revitalize the Parnamirim stream in such a manner while 18 (11%) still considered themselves unable to judge. There were no statistically significant differences in responses across the five urban form areas in the study in response to Question 5. This result thus suggests that following a brief discussion of urban stream revitalization practices perceptions held by residents of Area 5 changed in the same way as residents from the other four Areas. As given in Table 4, the residents of Area 5 initially had a majority preference (74%) for the channelized stream depicted in Photograph 2.

In response to the final interview question (only posed to those responding positively to Question 5) regarding what needs to be done to accomplish a revitalization of Parnamirim stream along the lines of the image shown to participants in Photograph 3, a range of answers were received (Table 10). There were no statistically significant differences

in responses across the five urban form areas in the study. What the three most frequent responses all had in common was a sense of citizen and government responsibility alike for management of the stream and to engage with the community in the process. The remaining answers pointed to particular actions that could be undertaken to enhance or clean up the Parnamirim stream such as: providing grassed areas, tree planting and other revegetation of stream banks; widening the stream bed, and enhancing public access as well as direct exhortations to simply ‘clean up the stream’ or to avoid dumping of sewage and garbage in the stream.

## 4 Discussion

Several key results emerge from our survey. Firstly, while a majority of respondents overall indicated that the Parnamirim stream looks like a highly modified and degraded stream (as depicted in Photograph 1), the selection of photographic image typically matched the characteristics of the stream in their particular area of residence (Tables 5, 6). Thus, people’s perceptions are influenced by the quality of their immediate environment. Secondly, while respondents overall were initially approximately equally divided in terms of preference for the revitalized urban stream from England depicted in Photograph 3 (50%) and the channelized stream with partial revitalization depicted in Photograph 2 (46%) (Table 3), we interpreted the kind of improvement to the stream they identified in response to interview question 4 as representing a kind of ‘step up’ from the current status in their area; i.e. people living in vicinity of the most degraded parts of Parnamirim stream preferred the channelized form while those in existing channelized areas preferred the more natural looking form with vegetated soil banks and social infrastructure (Table 4). The notion that channelization represented a form of urban stream revitalization was held by 27% of respondents, notwithstanding higher proportions of respondents (42%) identifying making it more natural as key here (Table 8). Finally, following discussion of urban stream revitalization options and possibilities, two thirds of respondents (67%) agreed that it would be possible to revitalize the Parnamirim stream in the manner of the stream depicted in Photograph 3 (Table 9) and a range of options for accomplishing revitalizing of the Parnamirim stream were advanced (Table 10).

**Table 10** What needs to be done to make this happen? [i.e. to revitalize the stream] (answers provided by people who said Yes to Q5)

(i) Initiatives of the population and public administration [respondents did not specify kinds of initiatives]	25 (22%)
(ii) The responsibility lies with the municipality and the urban planners	23 (20%)
(iii) Education of the population by the public administration	23 (20%)
(iv) Practical suggestions [particular initiatives specified <sup>a</sup> ]	20 (17%)
(v) Education and awareness of the population	7 (6%)
(vi) Clean	5 (5%)
(vii) Avoid dumping of sewage and garbage	5 (5%)
(viii) No answer	5 (5%)
Total	113 (100%)

<sup>a</sup>Canalizing with concrete walls/provide the lawn/afforestation/put in earth banks/remove irregular housing/widen the stream bed/treating sewage/reduced road space/revitalize some stretches of the creek

In short, our results indicate that the perceptions of interviewees regarding the Parnamirim stream and potential for revitalization were influenced by the quality or condition of the stream in the area where they live and by the discussion employing photo-elicitation. We now discuss these key findings in the context of previous studies in the published literature and the implications for interventions with communities to foster urban stream revitalization.

#### 4.1 People's perceptions are related to local environmental quality

Results obtained from the initial interview questions using photo-elicitation to illustrate examples and options that ranged from a degraded version of an urban stream to one that has been revitalized to restore ecological and social values were found to be related to the local environmental quality of our study participants. Our results suggest that more negative perceptions of urban stream revitalization potential are associated with experience of poorer environmental quality.

Similar findings are evident in other published studies. Zylstra et al. (2014), for example, noted that psychological and physical severance from natural areas (e.g. similar to the covering over the Parnamirim stream experienced by residents in Area 5 in our study) are drivers of humanity's disconnect from nature and negative implications for conservation efforts. In a study conducted in South Africa, Anderson et al. (2007) reported that households living in a worse environmental situation to others in their study were more likely to perceive environmental problems. Similar findings were reported by Abraham et al. (2016) who surveyed 10 communities and reported behaviour regarding water and other environmental conditions for urban waterways in Accra, Ghana. Perceptions were found to be directly influenced by unclean water and the bad smell from a waterway leading people to form the opinion that the water is polluted and therefore, just a drain or channel for waste water. The waterway was considered to have lost the status of a "river" and therefore comparable to any channel in the city which serves as conduit for wastewater. The authors concluded that a holistic approach to water and sanitation problems should be adopted in which interventions to respond to social problems are coupled with effective and efficient service provision (Abraham et al. 2016).

Numerous other studies point to a mixture of personal and social influences on pro-environmental concern and behaviour which revolve around connection and interaction with nature directly or the opportunity to engage in education and learning about natural areas (e.g. Gosling and Williams 2010; Frantz and Mayer 2014; Gifford and Nilsson 2014; Wang et al. 2016). This is where opportunities for stream revitalization can be effective. Asakawa et al. (2004) recorded positive perceptions of streams and adjoining 'greenway system' by nearby residential urban areas in Japan with support for revitalization programs in light of associations between quality of life and stream quality. Similarly, Ozguner et al. (2012) identified a dramatic change in public perceptions arising from a survey of public attitudes towards revitalization of a derelict urban streamside corridor in Turkey undertaken pre- and post-restoration works. They compared the previous and current condition of the survey site in order to reveal the influence of stream restorations on public perception and use of derelict urban landscapes. The results identified a dramatic change in public perceptions between the previous and current condition of the area. Revitalization was found to increase the value of the streamside area for people and to enhance their uses for recreational purposes. The pursuit of recreational activities was linked with connection to natural areas on public lands and the development of emotional attachments to special places in a



study conducted in the United States (Eisenhauer et al. 2000). This notion of social connectivity with rivers is a key focus of the work of Kondolf and Pinto (2017) who relate increased connectivity of people in urban environments when urban streams are restored to the surface environment and connectivity between city people and a river is realized.

Similarly, an evaluation of public attitudes to restoration works on three rivers using questionnaires and in interviews with local residents and restoration-scheme managers by Tunstall et al. (2000) showed that restored rivers can become well used and highly valued by the local people. It also indicated local residents attached importance to public consultation and expected to be consulted about river restoration works. Other studies have reported similar social benefits and acceptance of stream revitalization measures. In the case of the restored Cheonggyecheon stream in Seoul, Korea, Lee et al. (2014) reported that the new environment can arouse positive emotions that lead to visitor satisfaction and the recommendation of the area to others, eventually increasing support for the area and the project. The findings from this study also highlighted the value of providing green spaces for people based around urban streams that were previously covered with concrete being uncovered and developed into popular parks that contribute to urban regeneration.

To accomplish urban stream revitalization, achieving a shared vision and implementing that vision can be difficult, especially in situations where there is a high degree of variance within a community in relation to people's values and perceptions of the river (Thomson and Pepperdine 2003). Winz et al. (2011) point out while classically engineered infrastructure provides considerable social and economic benefit, particularly in urban settings, it diminishes people's exposure to, understanding of and connection with nature.

Currently in the case of the Parnamirim stream, there are limited opportunities for connectivity with the stream in most of the areas where we surveyed residents, due to canalization and buildings having been positioned directly over the stream. Nevertheless, there was clear preference for revitalization of the stream that would enable such use to be possible and our findings are consistent with previous research in urban settings elsewhere around the world. Importantly also, participants in our study identified both the behaviours of citizens and the role of discussion and awareness raising as ways forward for realizing future revitalization of the Parnamirim stream. Our findings also point to the value of the photo-elicitation method as a means of showing alternative images of what an urban stream might look like as a means of inspiring support for revitalization effort to be realized, which we address further in the next section.

## 4.2 People's perceptions on revitalization changed during the interview discussion

While our interaction with residents living near the Parnamirim stream was only for a short time, it nevertheless had a measurable effect on perceptions regarding urban stream revitalization. In part, it points to the power and utility of the photo-elicitation method in terms of provoking emotional and cognitive responses (e.g. Tonge et al. 2013). Finding new ways to communicate and understand ecological and social values was identified by May (2006) as being an important component of urban river revitalization programs. Although we did not set out to investigate the utility of the photo-elicitation method in this regard, our sense based upon our experience with the method is that it offers considerable potential as a valuable approach for engaging people and developing connection with their local environment. This accords with conclusions drawn by Hood and Reid (2018) regarding 'the power of photographs, together with a storytelling narrative to affect or to move individuals and, indeed, the wider community' (p. 760) to promote local identity and enhance how in

their case heritage organizations could effectively engage with their community. In a similar vein Ireland and Ellis (2005) reported on the power of photo-elicitation to ‘stimulate the conscience collective’ and give ‘collective meaning to [people’s] own existence’ (p. 373) in their study of ethnography in Cornwall, UK. Finally, in their investigation of place attachment by visitors to the remote Ningaloo Marine Park in north-western Australia, Tonge et al. (2013) concluded that ‘photo-elicitation is an effective tool for investigating people–place related constructs’ (p. 49).

Notwithstanding the power of the photo-elicitation technique we also acknowledge the potential for social desirability bias to influence our post-discussion preferences and comments regarding the potential for revitalization of Parnamirim stream. This phenomenon arises when respondents to surveys or interviews adjust how they answer the questions put to them to provide socially desirable responses and deny socially undesirable traits (i.e. to make the person appear favourable to the questioner) rather than the specific view that they hold (Nederhof 1985; Krosnick 1999; Grimm 2010; Stodel 2015; Lüke and Grosche 2018). Kim and Kim (2013) suggest that this is particularly the case when answering ‘sensitive questions’ for which respondents ‘over-report or under-report socially desirable (or undesirable) characteristics, putting themselves in a more socially acceptable position’ (p. 445) while Grimm (2010) notes that interviews are especially prone to social desirability bias owing to the presence of another individual.

Stodel (2015) suggests that if respondents use their subconscious to answer questions that have socially desirable answers, then they might be more likely to give an honest response, while in circumstances where they have the ‘opportunity to analyse their response and any ramifications, they are more likely to adjust their answer to something they believe is acceptable rather than one that is accurate’ (p. 320). The discussions between lead researcher and interviewees in this research potentially align with this scenario. Lüke and Grosche, (2018) do note a ‘tendency to favour inclusion’ (p. 45); i.e. prevalence of social desirability bias; when a respondent perceives that the interviewer (in our case) ‘has positive attitudes towards inclusion’ (p. 45). It is self-evident that our research was motivated by an interest in promoting urban stream revitalization. However, Stodel (2015) also discusses findings from fields of research where cognitive loading has been used to increase the reliance of research participants on their subconscious to assess options and make decisions. The nature of the discussion that took place with respondents in our research revolved around the somewhat technical concept of stream revitalization, notwithstanding our attempt to engage in normal spoken language with our respondents, and exposed them to consider new concepts and ideas. Although we had no means to control or account for potential social desirability bias in our research, the technical aspects of stream revitalization could be expected to represent cognitive loading which might mitigate this effect as highlighted by Stodel (2015).

Here, perhaps again, the interview process itself influenced the responses. Apart from the potential for social desirability bias regarding influence on responses to the interview questions, the research process itself represented a ‘bottom-up’ or citizen-based approach to the matter of urban stream revitalization, meaning that it was modelling and thereby implicitly promoting citizen engagement with such processes. Never-the-less it is a positive outcome for realizing the benefits of the urban stream revitalization in a more holistic way, suggesting that people are firstly willing to discuss the situation (i.e. as evidenced in local residents participating in this research) and secondly that they can start to see value and opportunity in natural environmental quality values, (given that the majority of respondents had previously identified Parnamirim stream as looking like a degraded stream).

In other research, engaging in discussion has been shown to be important in enhancing attitudes towards urban waterways and opportunities for revitalization. For example, the study by Anderson et al. (2007) mentioned previously reported that level of education was significantly associated with perceptions, behaviours and awareness of water pollution related programs whereby water pollution was more likely to be seen as a problem where the head of a household had lower levels of education. Positive action in regard to urban stream revitalization by managing authorities is also associated with influence on the perceptions of residents regarding environmental quality and levels of awareness of issues. Faulkner et al. (2001), for example, reported that a survey carried out with residents in an area of London in relation to engineering and water quality treatment improvements for an urban stream was clearly beneficial in enhancing the awareness of residents regarding their environment and the role of their views in its management.

In the research of Morzillo et al. (2016), the more environmentally attuned worldviews of residents surveyed in urban localities in the United States were identified as a likely influence on an individual's desire to seek environmental friendly outcomes in relation to natural resources. We surmise that such views are more likely to result from active engagement and in response to local environmental quality as per our previous results. Thus, there is potential to realize a positive reinforcing loop whereby exposure to stream revitalization plans and undertakings will enhance connection with the stream and encourage people to take care of it. Engagement in discussion and sharing ideas through the use of photo-elicitation to share ideas on what is possible clearly contributes in the first instance and may represent an important first step in realizing urban stream revitalization.

## 5 Conclusions

In this research, we sought to understand the perceptions of a residential population about a nearby urban stream and the potential for revitalization utilizing a photo-elicitation interview approach. To this end interview surveys were carried out with 167 residents of the city of Recife, living close to the Parnamirim stream and within five different areas characterized by differences in housing form and treatment of the stream. The research has shown that many of the residents that live near to the Parnamirim stream where it is visible between roads, and has been partially rectified in a channelled stream preferred the photograph of the most natural stream model shown to respondents, whereas people who reside where the stream is covered over by low-income dwellings preferred the photograph of the partially rectified and channelled stream.

Use of photographic elicitation and discussion of urban stream revitalization with participants resulted in changed perceptions of the Parnamirim stream and its future potential. Notwithstanding the likely influence of social desirability bias in this study, following discussion of the benefits of the stream revitalization the residents begin to change their views in a positive manner according with the perspectives for sustainable management of urban streams evident in the literature and the role model provided through use of photo-elicitation. Ultimately there was a majority preference expressed for a more natural and accessible waterway. During the conversation participants realized the positive impact that revitalization of the Parnamirim stream would create and that it would become advantageous to their community (e.g. through eliminating the current problems with unpleasant odours, flooding and other health risks). Participants in this study also recognized that current problems with the stream are at least in part a consequence of current misuse and

inappropriate behaviours by local people as well as government neglect. Overall, the way in which communities value the streams in their neighbourhood plays a significant role in determining their motivation to foster urban stream revitalization and this in turn necessitates active involvement and responsibility from the community. These findings accord with published research regarding similar investigations of community perceptions of local environmental quality, especially regarding degraded and revitalized urban streams.

Our research points to the value in promoting a positive feedback loop for those engaged in urban stream revitalization projects. A highly channelled and degraded stream is not attractive for people meaning that residents do not develop a favourable connection with it. The use of photo-elicitation and a discussion during interviews with residents proved effective in changing people's perceptions of the stream and its potential for revitalization in the future. When people develop a connection with the stream it encourages them to take care of the stream and providing information concerning benefits of stream revitalization contributes to improve people's perception. The community must be able to see positive outcomes and therefore value in the project in order to foster urban stream revitalization.

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