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Method Article

Deliberative Q-method: A combined method for understanding the ecological value of urban ecosystem services and disservices

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A B S T R A C T

There is a need, in the ecosystem valuation literature to compliment the economic methods with sociocultural valuation methods that capture and facilitate a better understanding nuanced social and cultural values that are difficult to measure. Yet, sociocultural valuation methods are often critiqued for their lack of structured and replicable procedures and for often maintaining limited internal research validity. Accordingly, this paper demonstrates the development and application of a mixed-methods valuation approach to better recognize non-use social and cultural values by integrating the triad of deliberation, local ecological knowledge, and value quantification. We operationalized this method in Amman, Jordan where we analyzed how local experts value, based on their local ecological knowledge, the ecosystem services supplied by the City's urban water features (fountains, ponds, and streams).

- We combine the conventional Q-method and focus group to yield a group deliberative Q-method.
- The deliberative Q-method facilitates a structured valuation framework.
- The deliberative Q-method method produces rich qualitative data.
- The rigorous statistical analysis of deliberative Q-method improves internal validity and streamlines qualitative data coding.
- The rigorous statistical analysis of deliberative Q-method weighs competing values to better understand polarized and consensus views.

A R T I C L E I N F O

Method name: Deliberative Q-method
Keywords: Sociocultural valuation, Urban planning, Deliberation, Local ecological knowledge, Value quantification
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Specifications table

Subject Area:	Environmental Science
More specific subject area:	Ecological economics, specifically ecosystem service valuation
Method name:	Deliberative Q-method
Name and reference of original method:	**Focus Groups:** Kitzinger, J. (1995). Qualitative Research: Introducing focus groups. British Medical Journal, 311(7000), 299-302. 10.1136/bmj.311.7000.299 Tyana, C., and Drayton, J.L. (1988) Conducting focus groups – a guide for first time users. Marketing Intelligence & Planning, 6(1):5-9. 10.1108/eb045757 **Q-method:** Brown, S. (1980). Political Subjectivity: Applications of Q Methodology in Political Science. New Haven, Connecticut: Yale University Press Watts, S., and Stenner, P. (2012). Doing Q Methodological Research: Theory, Method and Interpretation. Los Angeles, USA: Sage Publishing
Resource availability:	**Software (PQMethod):** https://qmethod.org/resources/software/

Method Details

Background

Broadly speaking, any benefits to human life that ensue from ecosystems are dubbed "ecosystem services" [1: 3]. To better integrate environmental benefits into land use decisions, experts apply ecosystem valuation by soliciting the public on an ecosystem's value and/or the value of its services. To date the majority of ecosystem service valuation studies apply monetary metrics, i.e., "monetary valuation methods" to weigh and measure people's perceptions of value and significance [2,3]. Although prevalent, monetary valuation faces challenges with regards to the monetary conceptualization of intangible values (emotional, affective, and symbolic views towards nature), hedonistic psychology, methodological individualism (self-interest), and utility maximization, hence, prompted the need for sociocultural valuation methods [4,5]. Surely, a variety of sociocultural valuation methods emerged that include: qualitative and/or quantitative research techniques (e.g., interviews and surveys, respectively); participatory and/or deliberative process (e.g., focus groups, citizen juries); and/or techniques that weigh social preferences in non-monetary, but quantifiable terms (e.g., Q-method) [6].

Yet, these sociocultural, akin to the monetary valuation methods, rely on aggregated individual values, which renders them incapable of capturing the nuances of cultural or shared values and the local ecological knowledge, particularly in multi-cultural societies –in other words, knowledge that may need to be drawn out through deliberation [3,4]. The local ecological knowledge (LEK) represents individuals' socially nuanced information about the environment, which is "accumulated over one's lifetime from observation and hands-on experience interacting with ecological systems and utilizing natural resources [7: 2]. Indeed, some sociocultural valuation methods (e.g., surveys, Q-method) continue to aggregate individual values, yielding weak value plurality [5,6]. This gave rise to the deliberative valuation methods that enhance value plurality [8]. Valuation methods that integrate deliberation recognize how values transform through dialogue that promotes mutual learning and through results that are informed by socially robust knowledge –knowledge that matches the objectives and that integrates the local ecological knowledge (see for example: [9–11]. But, unlike monetary valuation, deliberative methods generally do not quantify or rank values, thus are unable to identify which goods or services are considered "more valuable" than others (and possibly by how much). Such quantification of environmental values is essential for informing trade-offs in policy decisions (i.e., when choosing one environmental good or service over another) [12]. Deliberative methods are qualitative, hence when it comes to decision-making and policy formation, they tend to be operationalized ad hoc, applied after some decisions have been made, and produce un-actionable results [13,14]. This warrants combining qualitative (i.e., focus group) and quantitative (i.e., Q-method) sociocultural valuation methods to improve validity and credibility, which are especially essential and applicable for professional disciplines like urban planning where scientific, social, and political processes drive decision-making, especially for ecosystem services. Accordingly, we demonstrate

the deliberative Q-method that combines focus groups (qualitative) and Q-method (quantitative) to achieve a more holistic understanding of shared (group) and cultural values.

The methodological bases: focus groups and *Q*-method

What are focus groups and how have they been traditionally used?

Focus groups are facilitated discussions among four to eight participants typically lasting one to two hours, whereby a researcher/facilitator asks open-ended questions while encouraging inter-group communication, including the exchange of anecdotes, experiences and perspectives [15,16]. A discussion guide is used to structure the conversations and it may consist of flexible open-ended questions or group exercises like carded statements that the participants sort depending on a given criterion (e.g., relative importance: low, medium, or high) [16].

The focus group method intrinsically capitalizes on group interaction and deliberation to explore human knowledge and experiences, hence, it is useful for examining "what/how" people think and "why" they think that way [15]. The integration of communicative rationality and deliberative democracy theories in focus groups supports the idea that group processes (like face-to-face interactions, open discussions, and views exchange) can help individuals better explore and clarify their values [16, 17: 85–101, 18], and they promote synergistic interpersonal relations and mutual learning [19]. Although focus groups are a well-established valuation method, their role outside of scoping and pre-testing remains minimal [20].

What is Q*-method and how has it been traditionally used?*

Q-method's purpose is to understand, often elusive, human attitudes and perceptions using a systematic, structured and statistically rigorous approach [21–23]. Q-method uses quantitative analysis techniques to reveal differences in subjective perspectives; yet, it is best known as a "quasi-quantilogical" (i.e., quasi-normal distribution) technique where, similar to quantitative analysis, it has limited generalizability and helps to discover themes in rich subjective data [24,25].

Analytically, Q-method uses a version of factor analysis (Q-method) to systematically identify (through aggregation) groups of individuals that share common attitude structures (known as factors), achieved by considering people themselves and their whole response pattern as the study variables [23,26]. Factor analysis is a "statistical technique that reduces a large amount of data by clustering similar data and by extracting a small number of unique clusters that explain most of the variance or differences, in the data" [25: 3]. The clustering in factor analysis facilitates the use of Q-method for revealing patterns in large data sets [25].

Q-method is an **individually** preformed rank-order exercise, that uses subjective scaling to construct an index for intangible values where no scale currently exists [27]. Q-method determines what individuals consider significant by asking them to rank a set of subjective statements simultaneously. Each participant sorts these statements across a Q-grid to yield their own arrangement of these statements, whereby this arrangement, once completed by the participants, becomes known as a Q-sort (Fig. 1). The Q-sort itself is a quasi-normal forced distribution of columns that resembles an upside down pyramid. The Q-grid consists of columns made up of cells which are assigned a salience ranking, based on its columns positioning, ranging from -4 ("least how I think") on the left to +4 ("most how I think") on the right while the middle (0) signifies neutrality [28]. These "cells" are where the study participants place the sorting statements to yield a Q-sort. The limited number of cells on the Q-grid's opposing positive and negative columns warrants greater salience in the statements placed there. The nature of this distribution requires participants to make tradeoffs [23] –in other words, a participant cannot assign equal importance factor (whether high or low) to all the values and must make a decision about what is low value (i.e., "least how I think" which is a score of -4) to high value (i.e., "most how I think" which is a score of +4). Typically, *after* the participant performs the Q-method rank-order exercise, s/he is interviewed to probe out an explanation for why they ranked each statement as high or low [21,25].

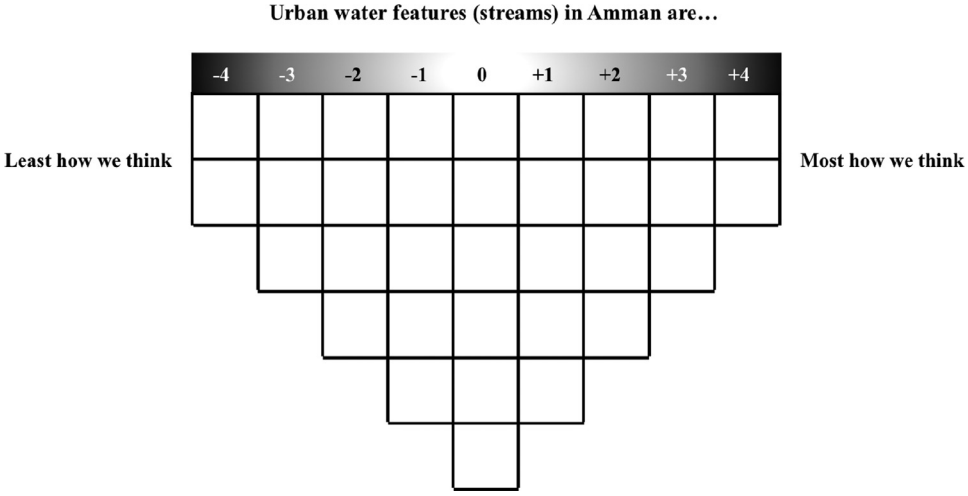

Fig. 1. The Q-grid: a quasi-normal forced distribution.

Applications of the Q-method abound especially in psychological research, and recently in conservation research [21,24,29–31]. Also, the Q-method is adaptable, for example O'Leary et al. (2015) applied Q-method alongside semi-structured interviews, using the Q-method results (i.e., significant statements) as a coding tool for interview data. Yet, Q-method remains non-deliberative and statistically aggregates individual values, rendering it limited in its ability to elicit shared or social values and/or to acknowledge the diverse forms of human communication (e.g., anecdotes and arguing). Thus, as in other non-deliberative forms of social preference analysis, the conventional Q-method compromises the richness and dimensionality of qualitative research [16,32], which might explain why Q-method's application in socio-cultural disciplines, like urban planning, remains limited [33] and to the best of our knowledge, its adaptation into a deliberative process has yet to be explored.

How does focus group methods fit with the research objectives/approach to study ecosystem values?

Focus groups provide an ideal forum to integrate deliberation into Q-method procedures. This in turn, improves the method's ability to recognize: (1) shared values (including transcendental values, cultural values, others-regarding values, for more on shared values see: [4]; (2) value plurality, and; (3) different forms of human communication. Compared to pre-formed individual values, shared values are collectively held; therefore, they are also collectively formulated [34,35]. Focus group methods explicitly use group communication to draw out nuanced information or values through deliberation, taking the research in new and often unexpected directions, which makes the method sensitive to non-market values and group norms [16]. In this respect, focus groups readily integrate Local Ecological Knowledge (LEK), representing individuals' nuanced and socially-constructed information about the environment that they obtain through their lived experiences in their own contexts [7,36]. Focus groups are explicitly deliberative, which also renders them sensitive to different forms of human communication (i.e., value projection), including anecdotes and arguing, hence revealing a dimension of understanding unique to qualitative research [16]. Therefore, focus groups provide a forum to improve the validity of sociocultural valuation methods by providing a deeper understanding of the subjective nature of human values. However, focus groups are limited in their ability to understand how participants prioritize or place relative importance on their different values [25].

How does Q-method fit with the research objectives/approach to study ecosystem values?

Q-method brings a more structured and replicable approach to the study of social perspectives and socially contested matters that are commonplace in multifaceted disciplines like urban planning [23,26]. In doing so, Q-method has the potential to increase the replicability and credibility of sociocultural valuations studies. This is because Q-method provides a structured ground for valuation; in other words, Q-method quantifies values, indicating what attributes are considered more valuable than others. Therefore, value quantification improves a study's ability to inform policy decisions where trade-offs are considered, and can lead to better informed, more transparent, and more defensible decision-making [12].

Importantly, through its ordinal rankings for subjective values, Q-method provides researchers with subjective scales that addresses the philosophical concerns surrounding value incommensurability, specifically, the use of monetary metrics to measure non-utilitarian anthropogenic, intrinsic, or moralistic values [2,12,37]. The ordinal rankings (i.e., information denoting rank or position, e.g., 1st, 2nd, 3rd) are particularly advantageous when setting priorities or making democratic decisions more so than valuation studies that produce quantitative information on cardinal scales (i.e., number counts representing a quantity, e.g., 2000 tons of sequestered carbon) that might convey "a false accuracy if uncertainties are not properly communicated" [38: 120].

A Combined methodology: a deliberative *Q*-method to evaluate the value of the ecosystem services of urban water features

To capitalize on the methodological advantages of the focus group and *Q*-method, and to overcome their individual limitations, this study proposes a mixed-method valuation approach that combines both. This novel combination transforms the Q-method from an individual activity into a deliberative group one, performed under conditions similar to focus groups, henceforth called '*deliberative Q-method*'. The deliberative *Q*-method combines, yet differs from focus groups and the conventional Q-method; accordingly, the deliberative *Q*-method is distinguished as follows:

(1) Unlike other quantitative methods, the *Q*-method does not operate on representative sampling whereby the objective of the method is not to extrapolate the findings to represent a larger population. Instead, the Q-method is a reductionist method used to isolate key trends and opinions in a purposefully selected sample group - in our case ecosystem/built environment experts in Amman, Jordan. The conventional Q-method is most often used on participant sample sizes of 12–40 individuals [27,39]. Our sample size was 20 participants divided over five group sessions that we dubbed A, B, C, D, and E.
(2) Unlike the conventional *Q*-method, which is an activity for individual participants, the deliberative *Q*-method asks participants to perform the rank-order exercise (distributing the sorting statements on a *Q*-Grid to yield a *Q*-sort) in small groups of four to eight people, for any number of groups as the research warrants. For this study, we carried out five deliberative *Q*-method group sessions (*A* through *E* as listed in the previous point).
(3) Unlike the conventional Q-method, whereby individual participants perform the rank-order exercise in isolation from the researchers, the deliberative Q-method is, like focus groups, a facilitator-moderated activity, whereby the researcher can oscillate between structured eavesdropping and interventions that encourage group discussions or equalize group power dynamics.
(4) Where the conventional Q-method aggregates individually performed Q-sorts (individual values) to extract clusters of people that share a similar point of view, the deliberative Q-method conversely, aggregates collectively performed Q-sorts (group values) to deduce commonalities in social perspectives.
(5) Under the conventional Q-method procedures it is common practice for researchers to conduct a short interview or survey *after* the participants perform the rank-order exercise to provide nuanced information about why each statement was given its specific ranking. This step is

Table 1
The combined method (highlighted steps represent those that diverge from conventional Q- method).

Conventional Q-method (Brown, 1980; Kállay, 2007; Watts & Stenner, 2012; Weber & Tuler, 2016)	Focus Groups (Tynan & Drayton, 1988; Ditzingerm, 1995)	The combination	
1. Defining research objectives a. Establish topic b. Selection of P-set (participants)	1. Preparation a. Establish research question(s) or hypothesis b. Define study population c. Recruit participants d. Select and obtain facilitators	1. Preparation a. Establish research objective/ topic b. Define study population c. Recruit participants d. Specify facilitator roles, obtain facilitators, not-takers and translators (if needed)	(I) Planning Before the rank-order exercise
2. Definition of the concourse a. Establish a concourse b. Select and edit Q-set	2. Develop interview questions a. Create moderator guide	2. Attribute development a. Establish concourse b. Select and edit Q-set	
3. The sorting process a. Ask participant to individually rank-order statements across the Q-grid b. Record Q-grid data c. Follow-up interview (optional)	3. Data collection a. Pose group questions to participants i. Foster participant engagement and equalize power dynamics b. Conduct sorting exercise (optional) c. Note taking to transcribe group discussion	3. Data collection a. Read sorting statements out load to participants b. Ask participants to deliberate and collectively rank-order statements across the Q-grid i. Foster participant engagement and equalize power dynamics c. Note taking to transcribe group discussion d. Record Q-grid data	(II) Data Collection During the rank-order activity
4. Data analysis (Mixed-methods) a. Correlation matrix b. Factor extraction c. Factor rotation d. Factor arrays	4. Data analysis (qualitative) a. Data coding and interpretation	4. Data analysis (Mixed methods - balanced) a. Correlation matrix b. Factor extraction (Principle Component Analysis) c. Factor rotation (varimax) d. Factor array	(III) Analysis and Interpretation After the rank-order exercise
5. Interpretation and reporting a. Develop crib-sheet b. Item score interpretation (informed by exit interviews) c. Factor write up		5. Interoperation and reporting a. Develop crib-sheet i. qualitative data coding of group discussions b. Data interpretation (item scores and deliberative comments) c. Factor write up	

redundant in the deliberative Q-method because the assigned note taker documents the group's discussions.

(6) Compared to focus group procedures that use a statement sorting exercise to structure group deliberation, the deliberative Q-method requires participants to sort statements across a quasi-normal distribution (Q-grid). The shape of the Q-grid's pyramid-shaped quasi-normal, distribution (i.e., fewer cells in the columns that have a greater salience value) affords the use of more rigorous statistical analysis procedures (factor analysis) to compare and reveal patterns in subjective data.

(7) In focus groups, unstructured data is, commonly, collected to be analyzed later using an inductive approach, which allows themes to emerge through a reflexive coding process [25]. In the deliberative Q-method however, the rank-order statements themselves (Q-sorts) serve to structure qualitative data coding – adapting Watts and Stenner's [40: 150-161] crib sheet approach.

Resultantly, our combined method (Table 1) amalgamates the *Q*-method's seven procedural steps [21] with the five steps of focus group research [41]. Our method consists of three phases: planning, data collection, and analysis and interpretation phases, that together organize one or more of our five

procedural steps: i) Attribute development; ii) Preparation; iii) Data collection; iv) Data analysis; and v) Factor interpretation.

Phase I: planning

Our method's first phase, *'Planning'*, took place before the fieldwork and consisted of two steps: *'Attribute development'* and *'Preparation'*.

Beginning with *'Attribute development'*, this step began with establishing a research objective, which should be exploratory in nature because the *Q*-method does not necessitate a priori postulation. In this case, our research topic sought to understand current perceptions and values of the ecosystem services provided by urban water features (fountains, ponds, and streams) in the city of Amman, Jordan [24]. We draw on the definitions of [42,43] regarding these urban water features. Specifically, [42] identify seven types of urban ecosystems from which we selected the ones that are based on "urban water".

Once the objective was set, we developed a "concourse" which is an exhaustive list of normative statements related to the ecosystem services of urban water features [44]. We developed this concourse by drawing upon the relevant literature (see for example: [42,43,45–47]). We also reviewed and combined in our concourse the classifications of ecosystem services provided both by the Millennial Ecosystem Assessment and the Common International Classification of Ecosystem Services (CICES V5.1, 18/03/2018). Primarily, we used the CICES classification system to produce a list of the relevant ecosystem services for Amman's context . We also classified the normative sorting statements under three of the MEA's ecosystem service classification to make it easier for the study participants to understand and to facilitate factor interpretation. These three higher order ecosystem categories are: (1) provisioning services; (2) regulating and maintenance services[1]; and (3) cultural services (please refer to the supplementary Table).

More importantly, we chose to also include ecosystem disservices in the concourse. Ecosystem disservices refer to "functions of ecosystems that are (or are perceived) as negative for human well-being"; they may result from natural phenomena and/or man-made influences (e.g., biodiversity providing habitats for insects and pests; natural disasters like excessive rainfall that causes flooding) [48: 228, 49]. We incorporated ecosystem disservices into the valuation framework because, as urban planners, we: (1) wanted to obtain a deeper understanding of the ecosystems' value, including their potentially negative functions (or negatively perceived functions); (2) we wanted the findings of this study to inform urban management plans through balancing competing perspectives; and, (3) we sought to derive creative problem solving and innovative design to overcome the disservice [25,48: 228, 49]. Because ecosystem disservices do not have an internationally accepted classification system (like CICES) we added a separate category for ecosystem disservices based on the work of [50–52], with the former two focusing on urban ecosystem disservices, and the latter, distinguishing economic, health-related and cultural ecosystem disservices (Table 2).

Developing this exhaustive concourse ensured that we sampled a contextually relevant and comprehensive set of statements – two cornerstones of validity in *Q*-method research [25,44]. From this concourse, we selected the most contextually relevant sorting statements that will be used in the study: a total of 34 sorting statements (27 ecosystem services and seven ecosystem disservices). Our selection was based on the statements' relevance to Amman's context (based on a review of the literature on Amman's water management [53–56]. The chosen statements on ecosystem services/disservices were simplified into naturalistic statements (prefaced by the phrase "urban water features are important because…") using phrasing and terminology easily understood by participants especially, when translated into Arabic (by a member of our research team who is a native speaker of Amman's local dialect). These measures (i.e., using 34 sorting statements and simplifying their language) sought to avoid "participant fatigue" by offering a breadth of statements on ecosystem services/disservices relevant to Amman's context that can be executed within a reasonable timeframe

[1] Because, what the MA defines as, 'supporting services' are not directly related to human well-being we chose to use CICES 'regulating and maintained' service category, which encapsulates these functional services.

Table 2
Ecosystem disservice classification for Amman Jordan.

Ecosystem disservice classification (Lyytimäki et al., 2008; Lyytimäki, 2017; Shackleton et al., 2015)			Simplified card statement	Statement No.
Ecosystem disservices primarily affecting human wellbeing with respect to economic issues	Ecosystem generated auctions, processes and attributes that result in economic development issues	Ecosystem functions or attributes that prevent (or are perceived to prevent) more profitable uses (e.g., for constructions)	Not important because they limit valuable land for development	(28)
Ecosystem disservices primarily affecting human wellbeing with respect to physical and mental health and safety ('health') issues	Ecosystem generated auctions, processes and attributes that result in safety issues	Ecosystem functions or attributes that cause (or are perceived to cause) fear anxiety or inconvenience	Not important because they provide habitats for pests	(29)
		Ecosystem functions or attributes that are (or are perceived to be) unsafe or hazardous (e.g., wet rocks near a stream as slipping hazard; waterbodies as a drowning hazard)	Not important because they are unsafe for human safety (e.g., drowning)	(30)
	Ecosystem generated auctions, processes and attributes that result in security and health issues	Ecosystem functions or attributes that cause (or are perceived to cause) human disease	Not important because they are unsafe for human health (i.e., disease)	(31
		Ecosystem functions or attributes that cause (or are perceived to cause) human toxicity	Not important because they have poor water quality (i.e., toxicity)	(32)
Ecosystem disservices primarily affecting human wellbeing with respect to cultural issues	Ecosystem generated auctions, processes and attributes that result in aesthetic issues	Ecosystem functions or attributes that are (or perceived to be) ill-managed resulting in unpleasant conditions (e.g., undesirable sights, noises or smells)	Not important because they are require ongoing maintenance	(33)
	Ecosystem generated auctions, processes and attributes that result in mobility and infrastructure issues	Ecosystem functions or attributes that limit (or are perceived to limit) physical and human connectivity	Not important because they divide the city (e.g., transportation networks and social divides)	(34)

(60–90 min). In making this decision, we drew on recommendations like Nyumba et al. [19] that when focus group discussions are longer than two hours, participants may suffer from fatigue, resulting in participant disengagement and weak deliberative results. Therefore, as a rule, focus groups last one to two hours, based on the complexity of the topic under investigation and the number of participants.

Once we finalized the sorting statements, we: 1) defined the study population; 2) recruited the participants; and 3) specified roles during the deliberative *Q*-method. To begin with, participants in *Q*-method studies are purposively selected (as opposed to randomly sampled) based on the question of interest to represent a breadth of opinions rather than be representative of a population [27]. To determine the study's population, we took several factors into consideration, primarily the fact that ecosystem services is a relatively new concept in Amman where it had only been recently introduced and is familiar only to experts involved in planning-related fields. The term 'expert' refers to a person with extensive knowledge or skills based on research, experience, or occupation [57].

Given the study's focus on a specific ecosystem in Amman, namely, public water features (fountains, ponds, and streams), our study's population target consisted of experts whose work (research and/or practice) influenced decision-making and public policy on urban water in Amman. Our decision draws on studies that similarly sought expert opinion on ecosystems (see for example: Drescher [58,59]. Furthermore, local experts combine their local ecological knowledge (lived experiences, observations, and mental models) and their formal knowledge (field observations and scientific knowledge) [60], which improves the credibility of the research results.

Accordingly, our recruitment began with consultations with local liaisons, namely: the Greater Amman Municipality and Columbia Global Centres, Amman ––one of nine such centers for Columbia University around the globe who provided us with an initial list of relevant individuals and organizations. We augmented this list through an exhaustive online search of all relevant organizations. Once we compiled a list of all relevant organizations, we contacted each by email, and followed up by telephone, and identified the suitable experts within each. Accordingly, we created a database of the target population whereby the database detailed each participants' job title, affiliation and contact information. It is essential to underscore that while some of these experts in our database were affiliated with international organizations, they were all Jordanian experts living in Amman, so they also represented local ecological knowledge. We invited each member on this database to our deliberative Q-method group sessions by email and followed up by phone. We also requested that they identify additional experts known to them whom we vetted for relevant expertise. In total, our database included 82 experts who were all invited of which 20 experts attended and participated in our deliberative Q-method sessions. This sample size represents the various expertise in the nascent area of ecosystem services in Jordan. Fig. 3 illustrates the participants' background information, including participant's gender, areas of interest or field of expertise, and professional affiliations. Eventually, the 20 study participants were distributed across three categories of expertise: 1) 'conservation and natural environment experts' (e.g., landscape architects, ecologists and conservationists); 2) 'infrastructure and built environment experts' (e.g., civil engineers, water resource engineers, architects and urban planners); and 3) 'socio-political experts' (e.g., social geographers, environmental policy experts) (see Fig. 3).

These experts hailed from a range of private, public, and NGO sectors at the municipal (e.g., the Greater Amman Municipality), national (e.g., the Ministry of Water and Irrigation, the NGO Wild Jordan), regional (e.g., the Arab Forum for Environmental Development and the Friends of the Earth Middle East), and international scales (e.g., German Society for International Cooperation). There were also academics at public universities (e.g., the University of Jordan, the German Jordanian University, and the Hashemite University) who hailed from the architecture, urban planning and design, and environmental management disciplines.

Lastly, due to the deliberative nature of our combined method, we applied a facilitator-mediated approach in which the facilitators acted as knowledge brokers who guided the participants through the rank-order exercise, fostered engagement, and equalized the power dynamics among the participants [19]. Accordingly, we equipped each of our deliberative Q-method groups with a facilitator, a note-taker who documented all the deliberations around the placement of each statement in the Q-sort, and a translator (Arabic-English) to ensure clarity of communication. Members of the research team received prior training on these roles to ensure the method's consistent application.

Phase II: data collection

Our method's second *'Data collection'* phase consisted of the rank-order exercise (distributing the sorting statements on a Q-Grid to yield a Q-sort) which we held over two days during April 2018. We conducted five deliberative Q-method group sessions (rank-order exercises/Q-sorts) at Columbia Global Centers, Amman. Each group was given a name across the alphabet from A to E. Each group session lasted around 90 min and was structured as follows: to begin with, the facilitators read aloud to each group a randomly selected statement from the pre-prepared sorting statements. The participants then discussed how closely this statement aligned with their values, and collectively sorted it into one of three preliminary piles: (1) positive salience; (2) negative salience; and (3) neutral salience, narrowing in on each statement's approximate location across the

Q-grid. The facilitators repeated this process for all thirty-four statements, after which, each statement was revisited one-by-one and the participants were asked to deliberate the rationale behind the placement of each statement on the Q-grid (-4 to +4). When consensus could not be reached, the groups deferred to majority-rule voting [61]. Throughout this process, our note-takers documented the deliberations (qualitative comments) for each group's discussion of every statement in the Q-sort which provided insights on each group's deliberations [62], particularly of instances where value transformation occurred (i.e., trade-offs). Note-taking also replaced the exit interviews in the conventional Q-method [22].

Once all the statements were preliminarily placed, our participants made their final adjustments so that the statement configuration (the final Q-sort) accurately represented their values. After all the statements in our preprepared sorting statements were ranked, we encouraged the participants to write, discuss, and replace any statement with their own comments so as to gauge any attributes possibly not identified by our research [22: 101]; however, none of our participants acted upon this opportunity –indicating that our statements covered all attributes regarding the ecosystem services and disservices of urban water features in Amman. After the participants were satisfied with the rankings of all statements, we used photography to document the data, whereby each groups' final arrangement of the sorting statements (the final Q-sort) quantitative study variable [27: 7].

Phase III: analysis and interpretation

Our method's third and final '*Analysis and interpretation*' phase took place after the rank-order exercise and consisted of two steps: *'Data analysis'* and *'Factor interpretation'*.

Q-method is a data reductionist approach, which renders a few (two to seven) common perspectives (factors) from a number of data inputs (Q-sorts). Our 20 participants gave rise to five, four-person focus groups, resulting in five Q-sorts.

Beginning with '*Data analysis*', our statistical procedure (factor analysis) follows standard Q-method protocol; accordingly, photos of each group's statements arrangement (Q-sort) were transcribed and entered into PQMethod 2.35 [63], a common (open-source) statistical package for analyzing Q-method data. Although this program semi-automates factor analysis, the process can be described by ***four conceptual stages*** (Fig. 2). The first is 'correlation'; whereby the numerical arrays of each of our Q-sort's (-4 to +4), were intercorrelated to identify participant groups that arranged their statements similarly [40: 97]. For example, our dataset revealed two correlation groups, first between deliberative Q-method groups B, D and E and second between groups A and C (Fig. 3). This correlation matrix was then subjected to 'factor extraction', which aptly titles our second stage. Under this stage we analyzed our numerous Q-sorts, producing groups of statement configurations that are strongly correlated across Q-sorts, known as 'factors' (or perspectives) [27: 10]. Specifically, the term 'factor' describes a cluster of deliberative Q-method groups that ranked statements in a similar pattern, and therefore, these groups' members shared a common point of view on the topic [25]. We applied a Principle Component Analysis (PCA) to extract a two-factor solution, which explains 78% of our study variance. These results are sound based on Kline [64: 28–42] who considers a solution explaining 35–40% of the study variance valid. Our decision to extract two factors was confirmed by statistically objective criteria, including:

(1) Kaiser-Guttman Criterion (extraction of all factors with an un-rotated eigenvalue $>$ 1.0 where factors with an un-rotated eigenvalue (EV) greater than 1.00 should be extracted [27: 10,40: 104]
(2) Humphrey's Rule (factors are considered significant when the cross product of their two highest factor loadings [irrespective of their sign] is equal to or greater than twice the standard error. Factors are significant when the cross product of their two highest factor loadings (irrespective of sign) exceeds twice the standard error, or when less strictly applied, the cross product simply exceeds the standard error [40: 108]
(3) Accepting factors with two (or more) significant factor loadings ($\pm$ 0.44 at $P < 0.01$). Factor loadings represent the correlation strength between each Q-sort's actual sorting configuration

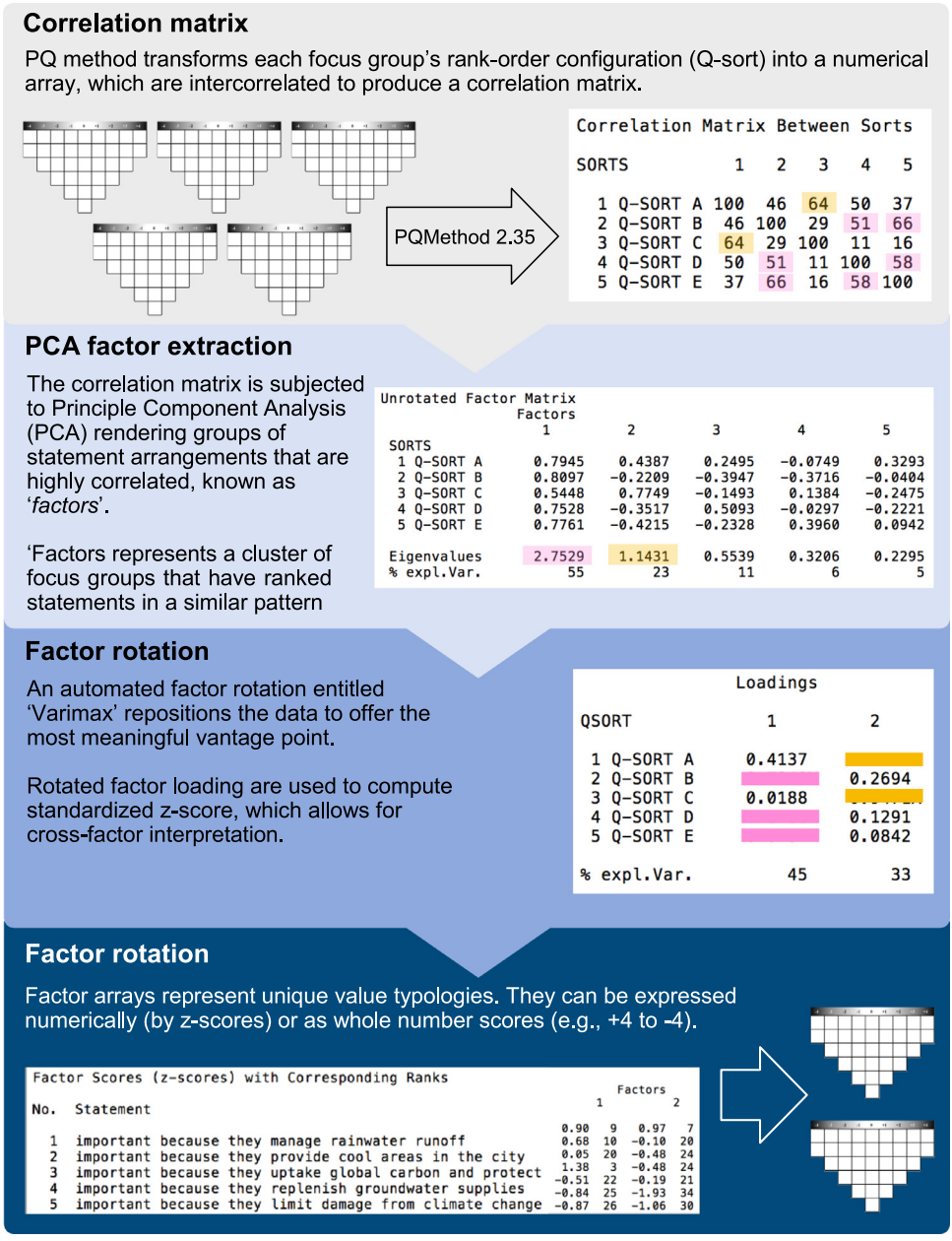

Fig. 2. The four conceptual steps of factor analysis.

and the respective factor that it informs. Factor loadings are considered significant at the 0.01 level when the factor loading is ≥ 2.58 x (1 ÷ √no. of sorting statements) [40: 104–107].

We chose to run a PCA over a centroid analysis since its algorithm considers both the commonality and specificity of the study variables (i.e., Q-sorts) [27: 11]. The third data analysis stage is entitled 'factor rotation', which simplifies our data interpretation by orienting each factor's viewpoint onto the

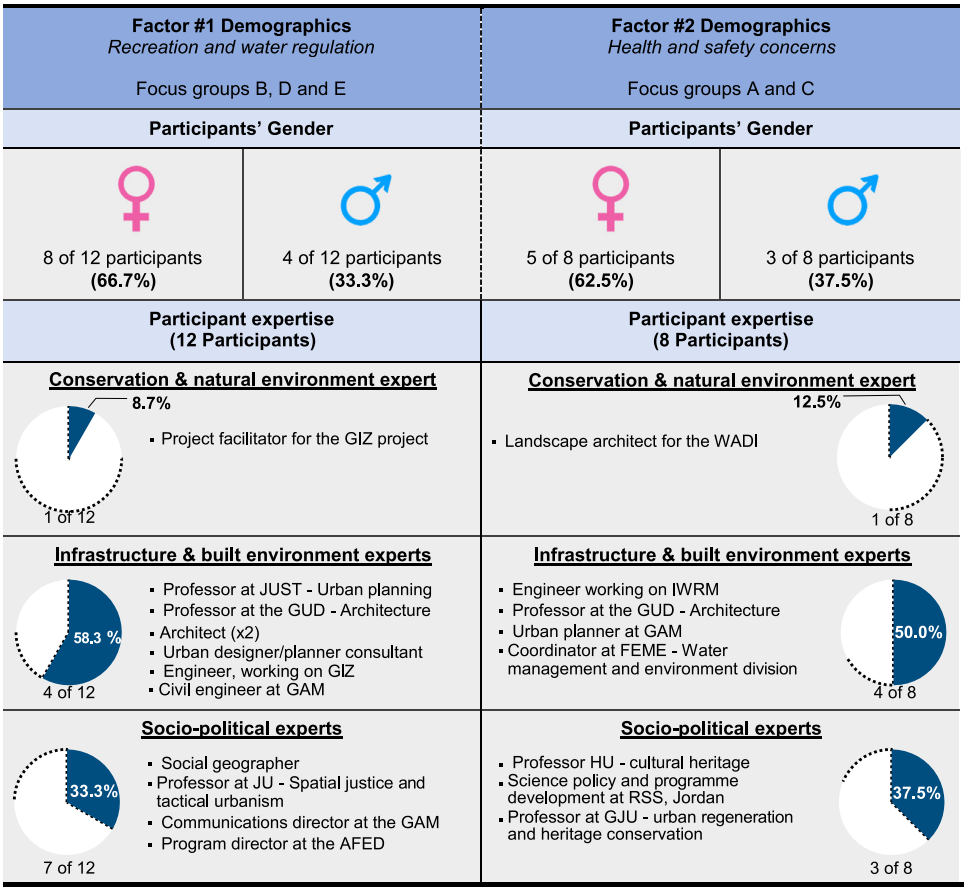

Fig. 3. Factor demographics.

most meaningful perspective, akin to drawing a line of best fit. We performed a computer-automated factor rotation entitled "varimax" to improve our study's reliability and to reduce researcher bias [27: 10, 29]. We manually 'flagged' all Q-sorts with significant factor loadings, which were used to inform our two-factor solution. Lastly, a single Q-sort representing each factor's typological perspective was produced, known as a 'factor array' whereby "A factor array, is, in fact no more or less than a single Q-sort configured to represent the viewpoint of a particular factor" [23: 140]. The statistical program normalizes the factor arrays' weighted statement scores and transforms them back into whole number rankings (−4 to +4), which we used to cross-compare factors [40: 150–161].

The second and last step in our method's *'Analysis and interpretation phase'* is *'Factor interpretation'*, in which we combined quantitative and qualitative data findings to make abductive inferences – informing 'how' and 'why' participants ranked each statement. We adopted Watts and Stenner's

[40: 150–161] crib sheet approach to ensure a systematic interpretation process that accounts for all statements and their interrelations. The crib-sheet method organizes statements by focusing on items that are ranked higher or lower in a particular factor relative to another, known as "distinguishing statements" [44,65]. Akin to O'Leary et al. (2015), we used the rank-order statements as the code structure for the qualitative analysis of the comments for the deliberative Q-method group sessions (differentiated by factor and group number). In other words, under each statement within the crib-sheet resided utterances from the transcripts of the deliberative Q-method's group discussion that confirmed or further explained the corresponding statement's ranking. We then used the factor arrays to produce a "series of summarizing accounts, each of which explicate[d] the viewpoint being expressed by a particular factor" [23]. These viewpoints were constructed using: 1) careful consideration of each factor's overall statement configurations; 2) the factor's distinguishing statements (statistically significant, $p < 0.05$); and more importantly 3) each factor's most salient statement rankings (items ranked ± 4). The resulting narratives reflected a coherent expression of each factor, featuring the rankings that informed the interpretation at each stage (in parentheses) within the text (for more on writing factor interpretations see: [40: 150-161]).

The factor analysis of the Q-method enabled us to find meaningful comparisons and contradictions among a diverse cohort of participants, comprising different personal attributes and occupations. The analysis produced two prevailing social perspectives in Amman, with zero instances of confounded or null variables. These two social perspectives represent two competing water management paradigms in Amman, Jordan. Our first, and most prevalent perspective, Factor One – which we dubbed 'Recreation and water regulation', embodies a 'sustainable' water management paradigm, whereby participants highly valued ecosystem services that delivered local water management solutions including water features' contribution to groundwater recharge and the regeneration of the Amman-Zarqa Basin (the primary watershed in the region). This perspective supports more progressive water management practices, such as nature-based solutions that protect, sustainably manage and restore natural ecosystems to improve people-environment relations while simultaneously enhancing human well-being [66] an example of which is stream daylighting (i.e., "the practice of removing streams from buried conditions and exposing them to the Earth's surface in order to directly or indirectly enhance the ecological, economic, and/or socio-cultural well-being of a region and its inhabitants" [67: 10]. Whereas the second, Factor Two – which we dubbed 'Health and safety concerns', aligns with an 'engineered' water management paradigm – one that underscores the ecosystem disservices of water features, hence, supports (a more conservative) technical water management approach such as protective hard engineered (grey) infrastructure and stream culverting. The factor narratives explicating these findings are presented and discussed in [68] (please refer to the video in the supplement).

The advantages and limitations of the deliberative Q-method

Our deliberative Q-method's combination of elements of the "focus group" and the conventional "Q-method" offers many advantages, including:

- The deliberative Q-method incorporates group deliberation into the value framing process whereby:
  - Deliberation enables the researchers to capture subjective and socially constructed values, including people's emotional, affective and symbolic views towards nature, which are difficult to represent in monetary terms [2,3].
  - Group deliberation teases out subtle qualitative information that underlie social values to provide an answer as to 'why' the participants ranked statements in a certain way (+4 to –4) [25].
  - Group deliberation encourages participation from individuals intimidated by the formality and isolation of a one-on-one valuation exercise [16].
  - The deliberative process allows participants to express their values in their own vocabulary, generating their own questions and pursuing their own priorities to take the research in new and unexpected directions [16,34].

- The Deliberative Q-method acknowledges value heterogeneity and focuses decision-makers' attention on conflicting and converging values that can be used to predict and resolve policy conflicts and better inform legitimized management decisions [12,25].
- The combined method yields both qualitative and quantitative data findings, which can be used to cross-validate results and improve internal research validity.
- Incorporating qualitative data analysis tempers the risk of expressing a false sense of accuracy through quantitative measures for intangible values or values linked to uncertainty (e.g., climate change estimates) [23,38].
- The group rank-order exercise reduces participant-facilitator interaction and reduces researcher bias [15,25].
- The sorting statements in the Q-method provide a tool for consistent qualitative data coding, bring a replicable structure to the coding process (rather than an inductive/open coding approach) to reduce the likelihood of researcher bias and improve research replicability [25].
- The deliberative Q-method can be easily adapted for use in a variety of research topics and fields of study, it will require modification and adaptation in future research. For example, it may be adapted by the integration of photo-elicitation surveys (i.e., using pictures/photographs as the method's Q-sorts –i.e., sorting statements– to understand people's visual preferences). Or the deliberative Q-method may be adapted for scenario planning by carrying out two sets of deliberative Q-method sessions with the same participant groups but sorting statements that present different scenario options [5].

Our deliberative Q-method is not without its limitations that follow from its roots in the "focus group" and the conventional "Q-method", namely:

- Akin to other deliberative methods, our method is susceptible to the effects of unbalanced participant power dynamics. Differences in participants' social status, gender, class, education, and life experiences may hinder open and fair communication which may influence the study results [4]. In our study, we managed this limitation through a facilitator-moderated approach whereby we trained the group facilitators in advance to be attentive to these power dynamics and to use participatory tactics to ensure equal input from all study participants. We also took measures to control the impact of group composition by: (1) soliciting values from experts only (i.e., individuals within similar education and social status), and; (2) by arranging participant groups to have a balance of both gender and expertise. Accordingly, our study's two resulting factors do not appear to differ based on gender and occupation characteristics, as each perspective has a diverse demographic profile (Fig. 3).
- While the pre-conceived sorting statements guide the group discussions, they may also be restrictive of group discussions –limiting them to the contents of the statements [69]. However, we sought to overcome this challenge by asking the study participants to write down and swap out their own topic-related statements.
- Since, as per the Q-method forced sampling approach, the study population is not intended to be representative of a larger population, the generalizability of the study results are limited.
- The combined method yields a nuanced understanding of participants' social values 'in a snapshot in time', meaning the temporal variability of people's perceptions may change over time, hence may require further research.

Finally, we emphasize that for the purposes of ecosystem valuation, the deliberative Q-method is not intended to replace monetary valuation, but rather to compliment it. In other words, we perceive it to be used alongside economic valuations to create a deeper and more holistic understanding of ecosystem service/disservice values, specifically those related to shared, cultural, and transcendental values.

Direct submission or co-submission

Co-submissions are papers that have been submitted alongside an original research paper accepted for publication by another Elsevier journal.

Co-submission

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Additional information

Link to the research project's website: https://uwaterloo.ca/stream-daylighting/
Link to an interactive video demonstrating the method: https://uwaterloo.ca/stream-daylighting/research-methods

Description of author roles

Both of the titled authors contributed equally (50/50) in the development of this manuscript. Ms. Peck is credited with conceiving the presented idea to adapt conventional Q-method into a deliberative process. Ms. Peck preformed the statistical computations and data interpretation, and also, prepared the manuscript figures and supporting audio-visual materials. Through her advisory role, Dr. Khirfan assisted in the development of a rigorous methodological framework, facilitated the translations into Arabic, and contributed to the final design and implementation of the research method in Amman. Specifically, Dr. Khirfan is credited with integrating deliberative theories into the research method and with facilitating and coordinating the fieldwork in Amman, Jordan through her networks. Both authors provided critical feedback and equally contributed to Phase I and Phase II of this research method and to writing the manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.mex.2021.101547.

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