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Exploring shared public perspectives on biodiversity attributes

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Abstract

1. Researchers, practitioners and policymakers have widely documented the multifarious ways that nature influences human well-being. However, we still have only a limited understanding of how the public interact with, respond to and talk about attributes of biodiversity.
2. We used image-based Q methodology to explore the shared and contrasting perspectives people hold for biodiversity. This approach is a powerful way of allowing people to articulate what is, or is not, important to them, free from constraints associated with statement-based stimuli.
3. We used British woodlands as a study system, as they are accessible and well-visited by the public. The elements of biodiversity incorporated in the Q methodology represented vertebrates, invertebrates, trees and understorey plants and fungi.
4. The shared public perspectives varied, and the reasons underpinning those perspectives were rich and diverse. People articulated reasons related to an array of biodiversity attributes (e.g. functions, behaviours, colours, smells, shapes). Many of the perspectives transcended specific species or taxonomic groups.
5. Although woodlands were used as a study system, people referenced perceptions and experiences external to this habitat (e.g. within their gardens) and associated with their everyday lives. Cultural influences and memories linked to particular people and places were also prominent.
6. Few of the shared perspectives map onto the objective measures and dimensions that researchers use to describe and categorise biodiversity (e.g. rarity, ecosystem service provision).

KEYWORDS

Britain, culture, ecosystem services, human wellbeing, human–nature interactions, Q methodology, sensory, woodland

1 | INTRODUCTION

It is widely asserted in research, policy and practice that there are diverse benefits associated with human–nature interactions (e.g. Naeem et al., 2016; Naidoo et al., 2019). However, despite a wealth of research across a range of disciplines, there remains a paucity of nuanced evidence characterising *which* elements of the natural world people respond to, both positively and negatively. Indeed, the discourse pertaining to human–nature interactions is often highly generalised (e.g. 'green space', 'connectedness to nature'), yet both people and nature are heterogeneous.

Biodiversity, the living components of nature, is defined formally as the variability among living organisms and includes diversity within species, between species and of ecosystems (CBD Secretariat, 2000). People may characterise biodiversity by its attributes, whether that might be its different dimensions (e.g. species, habitats, communities), objective measures (e.g. species richness, species abundance), traits (e.g. morphology, behaviours) and/or functions (e.g. pollinators, decomposers; Lyashevska & Farnsworth, 2012; Smith et al., 2012). Despite the diverse and rapidly expanding literature on human–nature interactions, how people interact with, relate to and talk about biodiversity and its attributes remains an open question, with little understanding of which perspectives are shared across the public.

The literature highlights the myriad of ways by which human–nature interactions can occur. People can interact with nature both directly (e.g. bird watching, hunting) and indirectly (e.g. watching wildlife webcams online, nature documentaries; Keniger et al., 2013). Furthermore, people can visualise and imagine interactions without physically experiencing them, a phenomenon known as 'thereness' (Kaplan & Kaplan, 1989). Whether immersed in a landscape or perusing images in a book, people's perceptions of the attributes of biodiversity can be tangible (e.g. visual, olfactory, auditory, tactile) and intangible (e.g. symbolic, culturally significant, personal associations). Interpretation and societal understanding of the attributes of biodiversity have been studied for cultural variation (e.g. the non-universal nature of colour cognition and language; Goldstein et al., 2009), to successfully frame conservation messages to the public (Kusmanoff et al., 2020) and to create effective algorithms for mining biodiversity literature (Thessen et al., 2012). In species identification, there is also the concept of 'just knowing' what an organism is (e.g. 'jizz' in ornithology), where they are recognised by something more than their attributes, yet what this 'something' is cannot be easily articulated (Ellis, 2011).

Many studies investigate human preferences for environments, landscapes and species. For example, there is an extensive body of literature that has concentrated on the way in which spaces are managed, such as the presence and type of facilities, maintenance, accessibility and safety (Aspinall et al., 2010; Hong et al., 2018; Wendel et al., 2012). Additionally, many studies have explored broad concepts, such as the amount, greenness or broad aesthetic appeal of environments (e.g. Cameron et al., 2020; Massoni et al., 2018; Taylor & Hochuli, 2017; Weimann et al., 2019). Vegetation has also been examined, but this has generally been as part of the aesthetic appeal of an environment (e.g. Veitch et al., 2017). The studies that do focus on specific attributes of biodiversity are often rooted in particular contexts or policy-related questions, such as public preferences for species' immigrating with climate change (e.g. Lundhede et al., 2014), numbers/abundances of species of conservation concern in protected areas (e.g. Dallimer et al., 2015) or endemic as opposed to non-endemic species (e.g. Danley et al., 2020). Furthermore, many of these studies have tended to explore preferences among participants within a targeted or similar demographic (e.g. adolescents, older people), rather than the public as a whole.

In this paper, we use a combination of qualitative and quantitative inquiry to provide a rich and deeper understanding of how the public interact with, respond to and talk about biodiversity attributes. We use British woodlands as a study system because they are distributed across the country. They occur both inside and outside of urban areas and represent 13% of landcover (Forest Research, Forestry Commission, 2020). Moreover, they tend to be accessible to the public and are the third most visited type of environmental space behind 'urban parks' and 'paths, cycleways and bridleways' in Britain (Natural England, 2019). We engage members of the British public in a set of preference tasks (species that the participants would most/least prefer to encounter), using Q methodology with visual stimuli. Rather than testing hypotheses, it supports exploratory research from which subjective perspectives can be elicited from individuals (Hawthorne et al., 2008; Lu et al., 2018). The absence of a priori assumptions allows participants to articulate what is, or is not, important to them (Watts & Stenner, 2005). All the images were of species associated with British woodlands, occurring across different strata (e.g. understorey, canopy) and active at different times (e.g. diurnal, nocturnal, seasonally). The images were also of species that people could potentially encounter, ensuring that we could capture as many types of human–nature interactions as possible.

2 | METHODS

2.1 | Participants

Participants ($n = 50$) were enlisted via a social research agency to attend a workshop in February 2019. Individuals were recruited from both urban ($n = 40$) and rural ($n = 10$) areas across Britain (Scotland, $n = 2$; Wales, $n = 2$; England $n = 46$). They varied in age (18–29 year olds, $n = 16$; 30–59 year olds, $n = 17$; 60+ year olds, $n = 17$), gender (male, $n = 25$; female, $n = 25$), ethnicity (white British, $n = 40$; other ethnicities, $n = 10$) and social grade (AB, $n = 12$; C1, $n = 13$; C2, $n = 12$; DE, $n = 13$). Using these criteria, we aimed to capture the diversity of perspectives shared by the British public, including sectors of society who are often underrepresented in research (e.g. elderly, ethnic minorities, lower-income households; Fischer et al., 2018). Incentives (comprising travel reimbursement and financial remuneration on completion of the workshop) were provided to aid inclusivity.

The research process was approved by the School of Anthropology and Conservation Research Ethics Committee, University of Kent (Ref: 009-ST-19). Participants gave written informed consent prior to undertaking the research activities.

2.2 | Q methodology

Q methodology is a robust approach to explore human perspectives using a combination of quantitative and qualitative data analysis techniques (Guenat et al., 2019; Zabala & Pascual, 2016; Zabala et al., 2018). Participants are provided with a diverse set of stimulus items, known as the Q set, which they must rank and discuss from their own perspective (Watts & Stenner, 2012). While Q sets usually consist of statements on a particular subject, they may comprise anything that can be ranked and discussed by participants (Watts & Stenner, 2012). When using statements, participants can react to each one (i.e. agree, disagree or neutral), and then discuss how the statement does, or does not align with their personal viewpoint. In this study, we used images as our Q set stimuli (Figure 1), giving participants free rein to focus on whichever attributes were important to them when ranking and discussing the items. Images are a particularly useful way to generate discussion as they are more universal in appeal than statements (Sherren et al., 2010). They create opportunities for the participant, rather than the researcher, to articulate what is salient, as an image may be ranked differently (or the same) by participants looking at different attributes (Van Auken et al., 2010), potentially meaning that participants who rank images in the same order give very different reasons for those ranks. Images can also access participant's tacit, sometimes unconscious, use of characterisations and metaphors (Van Auken et al., 2010). Moreover, images have the potential to cross literacy and language barriers, helping to produce richer and more participant-led data (Milcu et al., 2014; Sherren et al., 2010). Image Q sets have been used successfully in previous research using Q methodology, focusing on issues such as the creation of recreational trails (Hawthorne et al., 2008), public views on windfarms (Beckham Hooff et al., 2017), land-use change (Lu et al., 2018; Swaffield & Fairweather, 1996) and landscape preferences (Milcu et al., 2014).

The Q set needs to comprise an assortment of heterogeneous items that reflect variety in the subject matter and are communicable (Watts & Stenner, 2005). In this case, the research team selected images to embody a diverse mixture of attributes, informed by the literature (e.g. Larsen et al., 2018; Smith et al., 2012; Sumner et al., 2018; Zhao et al., 2017). These included traits (e.g. colours, morphologies, textures, sounds, smells, behaviours), functions (e.g. food provision, pollination) and cultural significance (e.g. folklore, popular media, symbolic). Due to the high levels of biodiversity in woodland, we created four broad Q sets to make the preference task manageable: vertebrates (n = 32 images), invertebrates (n = 43), trees (n = 32) and understorey plants and fungi (n = 32). The invertebrate Q set was larger to account for the greater diversity of species. The multiple Q sets also allowed us to compare and contrast shared preferences for attributes (i.e. traits, functions and cultural significance) across the broad taxonomic groupings.

The Q set images were all illustrations from identification guides, presented against a white background to minimise the influence of context and artistic style (Figure 1). They were presented on A5 cards, each having a unique number within the Q set (i.e. 1 to 32, or 1 to 43). Throughout the study, the researchers referred to image numbers rather than species names. Participants could then discuss images without needing to identify or name the species, facilitating a focus on attributes.

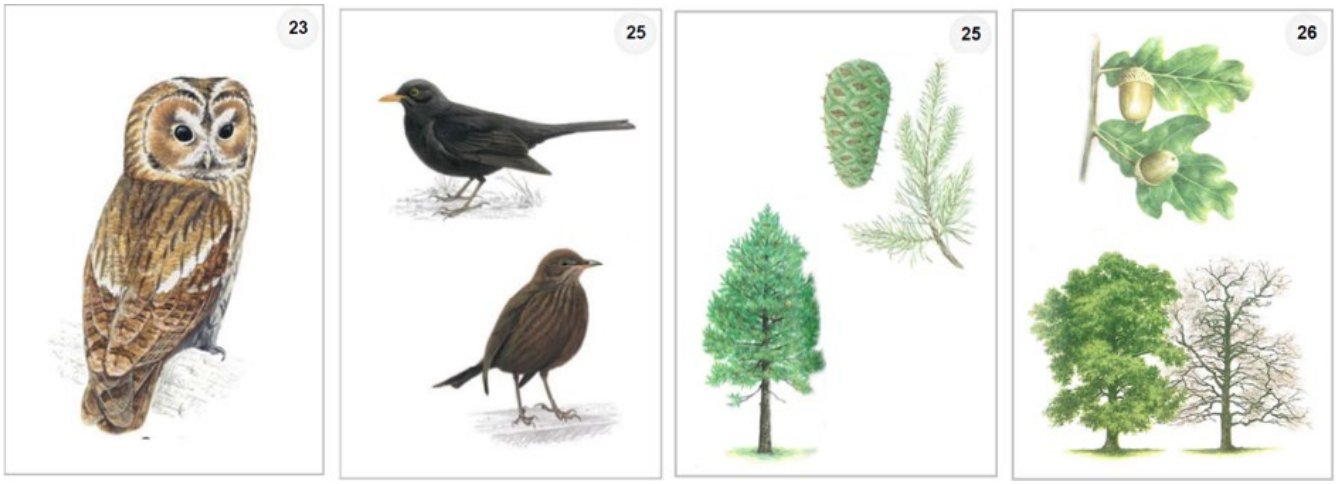

FIGURE 1 Example images used in Q sorts to explore how the public interact with, respond to and talk about biodiversity attributes associated with British woodland species. Due to the high levels of biodiversity in woodland, we created four broad image-based Q sets to make the preference task manageable for the participants: vertebrates, invertebrates, trees and understorey plants and fungi. Each participant was asked to complete a Q sort for all four of the Q sets. Left to right: tawny owl *Strix aluco*, blackbird *Turdus merula*, lodgepole pine *Pinus contorta var. latifolia* and English oak *Quercus robur* (bird images courtesy of Mike Langman via rspb-images.com and tree images courtesy of John Kilbracken)

2.3 | Data collection

Data collection in Q methodology, called the Q sort, is performed in two stages: a sorting task, followed by a post-sort interview (Watts & Stenner, 2012). Each participant was asked to complete a Q sort for all four of the Q sets, the order of which was randomised to limit the possibility for bias due to fatigue. For each Q sort, participants were given 10 min to rank the Q set images, guided by the following instructions: '*We ask that you choose the pictures that represent what you would most want to encounter or come across in woodlands in England, Scotland or Wales, and what you would least want to encounter. Take your time to look at the pictures carefully. There are no right or wrong answers, as this is entirely based on your personal views, thoughts and reactions. Do not worry about the artistic composition or quality of the pictures, but think about the characteristics and attributes of what you see. Please do not worry about naming it correctly or identifying it*'. We used the phrase 'preference to encounter' following extensive testing in focus groups and pilot data collection exercises. It elicited the widest variety of responses from our participants, covering different types of human–nature interaction (e.g. direct, indirect, incidental, thereness; Kaplan & Kaplan, 1989; Keniger et al., 2013), as well as drawing out both tangible (e.g. visual, olfactory, auditory, tactile) and intangible (e.g. symbolic, culturally significant, personal associations) perceptions of biodiversity attributes.

Participants recorded their preference rankings on an answer sheet representing a quasi-normal distribution grid (Brown, 1980; Figure 2). The image number of the species that the participant would most prefer to encounter was written in the top square box of the grid, through to least prefer to encounter in the bottom square box. Participants were told that each image number should only appear once throughout the grid, and that only a single image number should be placed in each of the square boxes (known as a forced-choice distribution). The single rectangular box in the middle of the distribution is therefore for the images where preferences are weakest (Watts & Stenner, 2012). We used a single rectangular box at the centre of our forced-choice quasi-normal distribution, rather than many individual square boxes, as participants found it easier to comprehend during the pilot data collection exercises. Once the grid is complete, the central rectangular box contained 23 image numbers for invertebrates and 12 for the other three Q sets.

After the sorting task was complete, participants were asked to talk through their rankings, guided by the following instructions: '*I'm now going to ask you to tell us why you chose to place the various pictures at the top and bottom of your sort, representing what you would most prefer to encounter and would least prefer to encounter. There are no right or wrong answers and we are interested in your personal views, thoughts and reactions to the pictures. When you are talking to us about the pictures, please think about the characteristics or attributes that might help us to understand why you placed it where you did*'. The post-sort interviews were audio-recorded and transcribed for analysis.

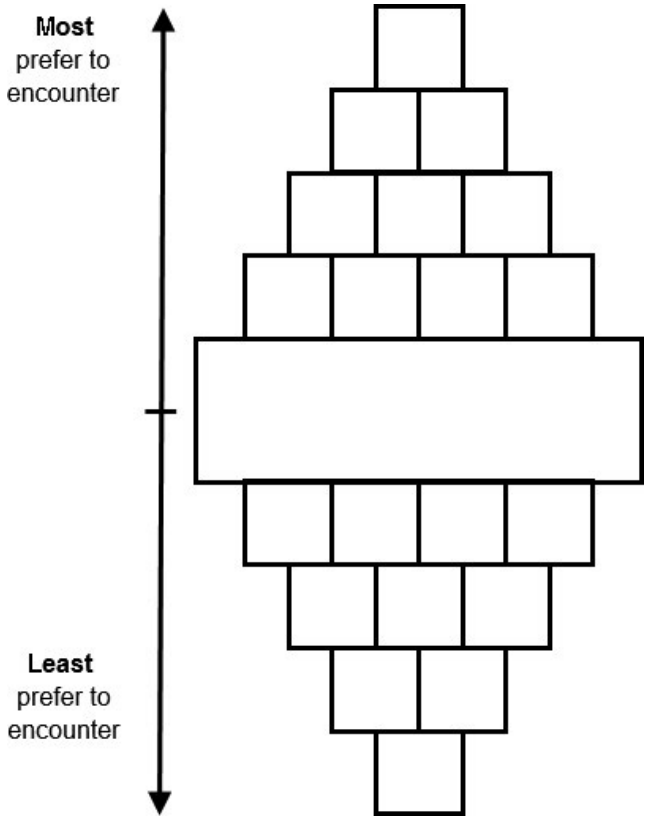

FIGURE 2 The answer sheet grid used by participants conducting a Q sort. The answer sheet represents a normal distribution, from most prefer to encounter through to least prefer to encounter. Participants were informed that each image number should only appear once throughout the grid. A single image number was to be placed in each of the square boxes in the grid. The central rectangular box in the grid was left as one large box of equal preference for ease of use. Once completed, the central box contained 23 image numbers for the invertebrates Q sort, and 12 for the vertebrate, tree and understorey plants and fungi Q sorts

2.4 | Data analysis and interpretation

All Q sort answer sheets were filled in by participants, so there was no attrition. However, some participants incorrectly completed their answer sheets by, for example, using a single image number in more than one box in the grid. These answer sheets were excluded from the analyses, resulting in a total of 158 (vertebrates, $n = 42$; invertebrates, $n = 36$; trees, $n = 38$; understorey plants and fungi, $n = 42$) taken forward for analysis. The four Q sets were analysed independently of each other, providing separate sets of results.

For each Q set, quantitative multivariate data reduction techniques were used to identify shared perspectives from across the individual views expressed (Zabala & Pascual, 2016). The ranking data from the Q sort answer sheets were intercorrelated and factor analysed using the package QMETHOD (Zabala, 2014) in R (v3.6.0; R Core Team, 2019). Principal component analysis (PCA) and varimax rotation (Ramlo, 2016) reduced the multivariate dataset to dimensions, known as 'factors' in Q methodology (Watts & Stenner, 2012). We applied the criteria that factors needed to have an eigenvalue

greater than 1, and that two or more participants must load onto a factor to represent a shared perspective (Sandbrook et al., 2013). Some participants did not load on any factor, and no participant loaded on more than one factor, signifying that the views captured by each factor were distinct from those captured by other factors (Watts & Stenner, 2012).

Factors are interpreted by studying factor arrays (a hypothetical Q sort for each factor, formed by calculating the scores for each image; Zabala, 2014; Tables S1–S4) alongside the corresponding transcriptions. Once the minimum quantitative criteria for factors were met (i.e. eigenvalue >1, two or more participant on each factor), the transcripts of all participants loading onto each factor were extracted and coded using NVivo (Version 12; QSR International Pty Ltd, 2018). These qualitative data were evaluated alongside the scores for each image in that factor array (Tables S1–S4) to identify shared perspectives, an iterative process of factor reduction until the factors could be interpreted as qualitatively different from one another. Defining factors in a purely statistical way can result in multiple factors that are very similar in terms of participant perspectives that underpin them. Too many factors meant that similar

TABLE 1 Factors emerging for each of the four Q sets of images used to explore how the public interact with, respond to and talk about biodiversity attributes associated with British woodland species. The number of factors that emerged were as follows: vertebrates, $n = 5$; invertebrates, $n = 4$; trees, $n = 5$; understorey plants and fungi, $n = 3$. The factors were named following interpretation of the post-sort interview transcriptions and identification of shared perspectives. The number of participants loading on each factor (n) and variance (%) explained by each factor are shown. The higher the % variance, stronger the explanatory power of the factor, and total variance is the sum of the individual variances

Q set	Factor name	Example statement	*n*	% variance
Vertebrates (total variance = 64%)	Appearance and behaviour in the wild	*I think they're clever, the way they track down their prey… They're fearsome and dominant looking*	11	19%
	Encounters	*I just find them kind of ugly and I can't imagine having a very interesting encounter with them*	8	19%
	Characteristic of woodland	*I found it really, really hard to say what I wouldn't like to see because the woodland is the right place for most of these animals*	6	12%
	Familiarity	*My top one is badgers because we get them in our garden*	3	8%
	Captivating	*To see something that you've not seen before is always cool…just like fascination*	2	6%
Invertebrates (total variance = 57%)	Purpose, function and benefit to humans	*…the bumblebee. I think it's, again, without it we're done for*	13	19%
	Harmless	*I always think butterflies as being very gentle and I just love to see them around me*	9	16%
	Encounter of spiders	*I think it's just their forms, the way they move, they dart about… getting cobwebs in your face when you're walking through woodlands. I don't like that at all*	6	15%
	Curiosity	*You don't often see them that much and it's interesting to try and work out what they are*	3	7%
Trees (total variance = 57%)	Childhood memories	*We used to call them Spinning Jennies. We used to drop them as kids and it would twirl down*	6	15%
	Size/shape and resource provision	*That's why I like yews, twisty, knotty stuff; stuff that will be there for quite a long time…anything that can be of benefit to other stuff*	8	13%
	Characteristic of woodland	*My top was the oak tree…the king of all trees, because I actually love the British countryside*	7	12%
	Flowers, berries, leaves and cones	*Absolutely love the holly. I love the texture. I love the colourful berries on it and the tiny, tiny, delicate little flowers that you get*	4	9%
	General likes and dislikes	*I just like it. The branches, the leaves, really just catching to the eye*	5	8%
Understorey plants and fungi (total variance = 54%)	Colour	*…they're so vibrant, the colours. I always go towards bright colours*	18	26%
	Colourful and complexity	*I like to see things that stand out. If you had a blanket without bright colours then it looks boring*	12	17%
	Appealing to the senses	*…because I think it's wild garlic and that smells beautiful. And I've put the brambles in as well because blackberry & apple pie is to die for…*	8	11%

perspectives appeared on more than one factor while too few meant that nuances were lost. While strength of preference is reflected by those images placed in boxes at the extreme ends of the forced-choice distribution, the location of all images can be useful in interpreting the factor array (Watts & Stenner, 2012). Quantitative analysis provides factors that group participants who ranked images in a similar way while qualitative analysis allowed us to determine the shared perspectives on biodiversity attributes rather than species per se. As well as elucidating which attributes the participants focused on, we explored how they related to those attributes, which could be positive or negative. Our approach to coding and qualitative analysis follows the logic of Interpretative Phenomenological Analysis (IPA). It assumes in this context that encounters with nature are a shared phenomenological experience that can be understood in analytical terms through the building up of codes inductively, set within a recognition that the data collected nonetheless reflects and follows a general schedule of questions and stimuli created by the project team. Factors were named according to the shared perspectives associated with the factors, in an analogous way to Q sorts that use statements (e.g. Guenat et al., 2019; Nijnik et al., 2018; Sandbrook et al., 2013). Given that the focus of this study was biodiversity attributes, the names thus reflect the shared perspectives for the attributes being discussed. For instance, for factor 1 for Q set 'Trees', discussions centred on memories in participants' childhoods, so the factor was named 'childhood memories' (Table 1).

3 | RESULTS AND DISCUSSION

The number of factors, indicating shared perspectives, was different across Q sets (vertebrates, $n = 5$; invertebrates, $n = 4$; trees, $n = 5$; understorey plants and fungi, $n = 3$), revealing a gamut of thoughts about biodiversity attributes other than just visual characteristics (e.g. colour, aesthetic appeal; Table 1). Not only did the number of factors extracted differ across image sets, but attributes that defined the factors also differed (Table 1). Our findings showed that while there was commonality in how people interact with biodiversity and its attributes, how and why people related to those attributes varied. Participants discussed the images in a multitude of ways, drawing on regular encounters, memories, associations, responses to particular behaviours and other sensory information (e.g. sounds, smells). The mechanisms by which participants expressed their perspectives revealed a wide use of allegory beyond generic terms, such as 'nice' and 'horrible'. Below, we discuss the results for each of the four image Q sets, before comparing and contrasting shared preferences for attributes across the broad taxonomic groupings.

3.1 | Vertebrates

For the vertebrate Q set, 30 participants loaded on five factors (Table 1). There was a general preference for encountering mammals and larger birds (e.g. tawny owl, goshawk), rather than songbirds. No factor reflected shared positive perspectives for amphibians or reptiles. Paradoxically, familiarity with the more common animals, especially those that participants encountered in their everyday lives (e.g. brown rats, grey squirrels, blackbirds) made them both the most, and least, preferred to encounter.

3.1.1 | Appearance and behaviour in the wild

This factor related to shared perspectives about behaviour, especially movement, coupled with appreciation for aesthetics, but not directly linked to specific attributes. These attributes were viewed positively for larger birds and mammals, but negatively for reptiles, rodents and bats (Table S1). Example observations include '*… the owl. So beautiful. It's so graceful…I love their faces, their feathers, they're just gorgeous*' and from another participant '*It's a nice activity to go and see the deer. They're quite big so they're more of an animal you can interact with. The baby ones look a bit like Bambi*'. Some people had encountered the vertebrates as roadkill or in zoological collections, and expressed the desire for, and the importance of, encounters with living animals in the wild. Two comments illustrate this: '*I picked the badger because I've never seen one alive…I also put deer because I've never seen one in the wild*' and '*if you manage to see a deer in the wild it feels like, 'I was lucky today, I saw a deer''*. Some behaviours were appealing, such as '*squirrels…scampering up the trees and things, quite interesting to watch*' while others were not, for example, '*any mouse, anything that scutters quickly, moves quickly, I don't like any of those*' or '*I'm scared of snakes. I don't really get how they move. They kind of confuse me. They creep up on you*'. Preference for encountering was also linked to how elusive an animal was perceived to be (e.g. deer, owls, badgers, dormice, treecreepers). Interestingly, negative perspectives, such as '*I'm not really a fan of the slimy snake*' stemmed from perceptions of appearance and behaviour and were not borne of experience.

3.1.2 | Encounters

Perspectives underpinning this factor were related to participants' imagined and previous encounters. Preferences were for encountering mammals and birds perceived as '*beautiful*' and '*smart*', and framed using favourable traits, such as the '*majestic owl*', '*harmless deer*' and '*gentle hedgehog*'. Some perspectives drew meaning from their association with the preferences of family members: '*Blue tit. They were my Grandad's favourite bird… it's very symbolic to me*', as well as '*my grandmother had a real fear of snakes… she put that on all the grandkids*' and '*My husband is petrified of snakes*'. This salient dislike of snakes also existed for bats and amphibians as illustrated by '*Snakes scare the living daylights out of me, always have done. And I don't like bats at all*' and '*…squishy and too easy to stand on. I have stood on frogs and then I always feel very bad*'. Negative perspectives were grounded in aesthetics and fear, with reasoning influenced by perceptions and anecdotes rather than first-hand encounters: '*It really scares me…*

imagine seeing that in the woods, with the long ears' (brown long-eared bat). These perceptions could be an unconscious reflection of how certain species are viewed in a wider cultural context, especially in literature, and the use of animal metaphors to represent human traits (Davey, 1994; Polák et al., 2019; Talebinejad & Dastjerdi, 2005).

3.1.3 | Characteristic of woodland

These participants discussed what they believed characterised British woodlands. Participants associated birds and some mammals with woodlands: '*pretty birds because I think there should be birds in woodlands*' or '*songbirds…stuff that adds character to the woodland itself*', and '*pine marten…it's hard to say what it is about it… I think you warm to stuff that is struggling, especially stuff that has got character*'. They also spoke about what the presence of some animals indicated about woodland, for instance, '*a bird of prey…means that it must be a healthy woodland*' or '*the pine marten…they're very difficult to see and they like a particular type of woodland*'. Grey squirrels were perceived as not belonging in British woodlands: '*…it's not meant to be there. I mean if I had no knowledge of it being what it is I'd be very inclined to like it*'. These participants did not associate rats, amphibians or reptiles with woodlands: '*lizards and snakes, reptiles and amphibians. I've got nothing against them, I just don't associate them with woodlands*'. Some people did not wish to encounter bats as they felt that they would never be in a situation by which they would be '*in a forest at night*'. Some perceptions of what a woodland should comprise had been influenced by stories: '*dormouse, just because it always reminds me of all the Beatrix Potter…the stories connected to these types of animals. So I love to see one of them* ' and '*tawny owl…I know I keep saying the word 'charismatic' but they are, and they've got a lot of folklore attached*', plus the idea that the woodland is where these animals belong.

3.1.4 | Familiarity

Although the study system was woodlands, this factor was based on encounters in everyday life irrespective of the setting. Every participant spoke negatively about rats. For example, '*You see them [brown rats] all the time…going through my bins*'. There was a preference for mammals that visited participants' gardens (e.g. hedgehogs, foxes, squirrels, bats, badgers): '*we get foxes and we get badgers actually coming into the garden on a regular basis*'. Indeed, these everyday interactions can be the basis for meaningful encounters with biodiversity (Folmer et al., 2018). While some welcomed an encounter with such mammals (e.g. '*I really like foxes. We feed them. They come into our garden. They're a delight, a pleasure*'), others did not. One participant who loaded negatively on this factor disliked foxes because they encountered them regularly in their urban environment. Furthermore, this same participant drew a distinction between foxes that lived in different habitats: '*urban foxes. They're not proper like bushy majestic foxes. They're just like little crap ones*'.

3.1.5 | Captivating

In this factor, participants again expressed a preference for encountering mammals, but here they expressed a disinterest in smaller birds. Woodland mammals, especially the pine marten, and larger birds, were described as expressing behaviours that would be exciting to watch, especially if for the first time. Illustrative comments include '*Foxes are really cute and really smart and just loads of fun to watch*' or '*It's just a cool looking critter. I've never seen one before*' and '*It would be quite interesting to watch. I've seen so many squirrels so something new would be good*'. Some of these expectations came from stories heard as a child: '*The badger and the fox and the hedgehog…It kind of reminds me of stories, like The Animals of Farthing Wood*'. Most of the discussions focused on behaviour. Many were anthropomorphised, which could reflect that animals are used as metaphors in various languages (Talebinejad & Dastjerdi, 2005) and to teach life lessons within stories (Larsen et al., 2018). These findings align with previous studies showing that people prefer species with which they have an affinity (Macdonald et al., 2015) and those considered '*charismatic*', '*cute*' or '*cuddly*' (Smith et al., 2012).

3.2 | Invertebrates

Four factors were extracted for the invertebrate image set, onto which 31 participants loaded (Table 1). In three of these four factors, the bumblebee and butterflies were preferable to encounter, but for different reasons (Table S2). How humans interact with, benefit from and are affected by invertebrate behaviour formed the basis of discussion. Lockwood (2013) notes that insects both frighten and mesmerise humans, and our paradoxical relationship with them is steeped in evolutionary history. Discussion around colour was common to all four of the invertebrate factors, especially in relation to butterflies, ladybirds and bumblebees. Colour can be used as a defence against predation (aposematism), which humans also notice. While several of the invertebrates in the Q set had black and yellow striations, participants focused primarily on other attributes that are more culturally ingrained. For instance, people described bees favourably due to their ability to deliver valuable ecosystem services, whereas wasps were stereotyped as dangerous (Sumner et al., 2018).

3.2.1 | Purpose, function and benefit to humans

The common thread in this factor was the purpose and function of invertebrates, to both the environment and to humans. A particular focus was pollination. The bumblebee was most preferred (Table S2) and was frequently associated with anxieties about environmental change: '*They're productive, they're endangered…and they're a good insect to have in the world*' and '*bees have been in decline so when you start seeing them you feel…a bit hopeful*'. Pollination was only attributed to bees, despite other pollinators in the image set

(e.g. hoverflies, butterflies, wasps). Bumblebees were also considered important as some believed that they produce honey, despite that only being produced by honeybees. Worms, ladybirds and spiders were perceived positively due to their functions, especially in gardens, as noted in this comment: '*worms and ladybirds are useful because they do look after my roses*'. Conversely, other behaviours observed in gardens made them least preferable to encounter, especially slugs: '*I dislike massively slugs and snails, anything like that, because they attack my plants. And I do kill them*'. There were also questions over the purpose of flies and members of the wasp family. These perspectives were illustrated with more personal expressions of nuisance, a source of irritation/threat and therefore lacking beneficial purpose to people: '*Is that a hornet? I just don't see the benefit to the environment*' or '*The wasp. The most pointless thing on Earth*'. This double-edged view of purposefulness is neatly summarised by reasoning about ladybirds: '*they eat all the aphids off the roses*' but also '*infest my house*'. The opinions expressed by participants echo concerns raised by some authors (e.g. Geldmann & González-Varo, 2018; Smith & Saunders, 2016) that although the mass media has raised awareness of the decline of pollinators, this role has been mainly attributed to bees, and the importance of other pollinators is overlooked.

3.2.2 | Harmless

Participants expressed preferences to encounter invertebrates that they perceived as harmless (Table S2). Attributes such as movement, colour (e.g. '*I am amazed by butterflies…I love the beauty of them, the colour*') and positive childhood memories (e.g. '*I always relate* [butterflies] *to childhood, to going into fields and seeing them all flying around*') were viewed positively. However, the shared perspective was the perception that encounters would be '*safe*', '*harmless*', '*gentle*' and '*calming*'. One participant described their selection as '*some sort of ladybird…it's a very safe, gentle creature to come across*'. Least preferred to encounter were attributes considered to be harmful (e.g. flying, biting, moving), as in '*the beetles and wasp…because I just think they can sting you*' or '[flies] *are dirty and we all try and avoid them coming in the home at all cost. And a lot of things that actually sting and bite, which I've probably experienced most of them, are not very pleasant*'. Other descriptors included annoying, for instance, '*I don't like the snails because it eats all the plants and leaves trail all over the place*'. The dor beetle was least preferred to encounter (Table S2), regarded as '*shiny so it seems slimy and venomous, even though it's not but it seems it*', demonstrating that knowledge of attributes (e.g. harmless) does not necessarily counteract judgements based on visual cues.

3.2.3 | Encounter of spiders

These participants form a separate factor due to a common disdain for encountering spiders, irrespective of the species (Table S2). Participants shared an aversion to a range of spider attributes including '*lots of legs, they move very fast and I just imagine them crawling on me*' and '*the way they move and look and everything*'. They also alluded to cobwebs: '*I just really don't like the idea of the webs…I find them sort of dirty, just dusty really*'. Spiders were described as being '*unpredictable*', '*repulsive*' and something to '*fear*'. This is similar to previous findings suggesting that movement and appearance are the attributes mainly influencing the fear of spiders (Lindner et al., 2019).

3.2.4 | Curiosity

These participants preferred to encounter '*unique*' invertebrates that piqued their curiosity as opposed to '*mundane*' ones regularly encountered. Each individual associated their curiosity with childhood memories as exemplified by '*when I was a kid you'd hear the noise and you'd try to track them down in the grass and then try to catch them*' and '*It reminds me of my childhood when I was grabbing at stuff*'. Curiosity related to different attributes, but most often movement, for instance, '*it amazes me how they can just move all these legs*' and '*snails just crawl up the wall*'. Interestingly, this was the only time that the attributes at different stages of a butterfly's life cycle were mentioned: '*when they're caterpillars they can be destructive…but when they're butterflies they're really pretty*'.

3.3 | Trees

In all, 30 participants loaded onto five factors. The English oak was prominent in the discussions (Table S3) and celebrated for being '*majestic*', '*quintessential*' and '*classic*'. Indeed, it is known to symbolise traits such as longevity, cohesiveness and robustness in the Northern Hemisphere (Leroy et al., 2020). While this reverence for oak trees was common, different factor arrays represent diverse perspectives, and is an example of the plurality of attention paid to the different attributes of the same species. Trees can be long lived and individuals are static. They display annual cycles that are predictable across seasons affecting appearance and behaviour (Zhao et al., 2017). Our data show that such life-history characteristics provide the opportunity for trees to become entwined in peoples' lives, with individual trees having the potential to be constant through a large part of a person's life, as well as acting as a seasonal indicator (Henwood & Pidgeon, 2001; Zhao et al., 2017).

3.3.1 | Childhood memories

Participants spoke about a variety of attributes, linking them to positive childhood memories (Table S3). There was a sense of trees being part of a wider socialisation and learning process: '*the oak tree…that's the first tree as a child you learn the name of, it's easy to spell, it's the first one you pick up on*'. Most memories were interactive, including imagination: '*I like acorns…when I was little I can remember taking them out and pretending to be teacups*', play: '*just childhood memories,*

playing conkers' and food: '*when we were kids we used to pick elderberries*'. Trees considered '*climbable*' were also important: '*I like the big slow-growing leafy trees…that evoke childhood memories*'. This behaviour in humans is thought to be linked to the rewards associated with arboreal foraging (Kraft et al., 2014). Additionally, individual attributes of trees (e.g. '*sticky buds*', '*conkers*', '*pretty flowers and berries*') had childhood associations. Active interactions with plants as a child have shown to be associated with positive values about trees as an adult (Lohr & Pearson-Mims, 2005).

3.3.2 | Size/shape and resource provision

The size, shape and provision of resources associated with longer lived trees were the common perspectives in this factor. Preference was to encounter deciduous rather than coniferous trees (Table S3), except for the yew which one participant described as '*ancient and old…quite a poetic sort of tree, evocative*'. The oak was the symbolic focus of such perspectives, described in terms of being a '*big, majestic tree. Slow growing…it's like the king of the woods*' and '*it seems such a symbol of history*'. The physical qualities of trees are part of how people construct meaning and understanding of the natural environment, with non-utilitarian perspectives reflecting that trees and woodlands resonate with people culturally at personal and community levels (Henwood & Pidgeon, 2001). Shape was also considered important in terms of a tree being suitable to climb: '*they've got character, you can climb them, so it's more than just a tree standing there*', whereas evergreens were considered: '*boring to look at…very kind of straight…not very branching*', as well as '*the prickly ones…you can't climb them*'. There is evidence that preference for deciduous trees over conifers is not only linked to size and shape of a tree but also the ratio of the crown size compared to trunk height (Gerstenberg & Hofmann, 2016). Mature trees were also associated with provision of resources that benefit both humans (e.g. '*eating chestnuts*', '*made elderflower cordial*', '*conkers for games*', '*cones for decoration*'), as well as wildlife: '*they shelter a lot, they feed a lot of things*' and '*it can feed animals and birds*'.

3.3.3 | Characteristic of woodland

Participants shared perceptions of which attributes characterised woodland, along with expectations of what a woodland should look like, for example a mix in height, shape, colour and seasonal variation (Table S3). Perspectives around seasonality included '*holly…you'd like to see something evergreen, and the berries and the white flowers that come out before…it is one of the nicest trees in the woodland in the winter time*' and '*I like conker trees, sycamore trees, things that drop stuff… it reminds you of the time of the year*'. Larger trees were again preferable to encounter, illustrated by comments such as '*I prefer the bigger, more sort of standout'ish trees'* and '*they've obviously taken a long time to grow that tall, are quite majestic. Like a proper tree*'. This perspective was complemented by trees that were '*uninteresting*' or '*weedy*' being the least preferred to encounter: '*I don't know what it is but it looks just insipid and useless…it just looks like nothing in particular*' and '*branches coming out from the floor…makes it less inviting to go into that part of the woods'*. Humans have been shown to prefer forests with mixed composition and tree heights over uniformity (Filyushkina et al., 2017). Here, participants' preferences to encounter were also linked to variety occurring due to seasonal change.

3.3.4 | Flowers, berries, leaves and cones

Within this factor, preference was for encountering attributes associated with flowers, leaves, berries, cones, without reference to the structure of the tree itself. The colours, shapes and textures of flowers, leaves, berries and cones were appealing, exemplified by comments such as '*I like pine trees because I love cones*' and '*the colours and the ones that you see flowers and blossom on, and fruit and berries and things*'. These perspectives were predominantly positive: '*seems brighter and a bigger variety than just all green all the time*' but not always: '*don't like the horse chestnut because …there are sticky buds, they get all over my shoes and it drives me crazy*'. Furthermore, some of these attributes were viewed positively as they were likely to attract animals (e.g. birds) that participants wished to encounter.

3.3.5 | General likes and dislikes

Participants expressed generalised views on the appeal of trees. However, when prompted to elaborate, they were not able to verbalise their perspective in relation to specific attributes. Statements such as '*I just liked it, I don't know why'* and '*I just like it. The branches, the leaves, really just catching to the eye*' showed a general appreciation. Furthermore, comments such as '*Just really not nice to look at really. Nothing about them*' and '*Not as aesthetically pleasing but quite nice*' provide an indication of perspectives towards trees that rely on a generic 'feeling' rather than relating to specifics.

3.4 | Understorey plants and fungi

For the understorey plants and fungi, 38 participants loaded onto the three factors (Table 1). There was a strong focus on visual attributes, especially colour, but perspectives included attributes affecting other human senses, such as smell and taste. Each factor showed a preference for encountering flowering plants over grasses and mushrooms, especially for flowers perceived and described as 'colourful' (Table S4). The colour of objects in the natural environment serves various functions, such as indicating that a fruit is ripe, for camouflage or for attracting pollinators (Marshall, 2010). Colour is also linked to emotions in humans, linked to both single colours and colour combinations (see Ou et al., 2004). Colour is not a physical property of an object, but a psychological property that is unique to that observer (Palmer, 1999). Socially and culturally, vision is widely

regarded as the most important sense (Hutmacher, 2019), and colour cues may dominate what is just one part of a multi-sensory woodland experience.

3.4.1 | Colour

There were shared preferences to encounter spring and summer flowering plants and not to encounter fungi (Table S4). Many participants related positively to '*colourful flowers*' being aesthetically pleasing, commenting, '*it's always the pinks and purples that seem to jump out to me*' and '*they're just pretty aren't they*'. Preferences were also framed in terms of the properties of colour, distinguishing between those considered *'bright*' and '*vibrant*', or '*plain*' and *'boring*', rather than the colours themselves. Green and brown flora were described as lacking colour and therefore considered less interesting: '*they're just green. There is no attraction, nothing to them*'. Fungi were the least preferred to encounter: '*mushrooms that are kind of beiges and browns are not very attractive*'. The fly agaric toadstool caught people's attention due to being bright red, as well as its association with popular culture and mythologies (e.g. '*fairies*', '*Disney*', '*Super Mario*'). Participants also believed that '*drab*' fungi looked dangerous yet, paradoxically, these were mainly edible while the fly agaric is highly toxic.

3.4.2 | Colourful and complexity

Within this factor, discussion was around both colour and complexity (Table S4). Bright, vibrant colours made some flowers and mushrooms '*eye-catching*' and provided variety. In addition to vibrant colours, participants noted the importance of shape: '*mushrooms are just fantastic shapes. Some are really gnarly and some are very smooth tops*' and structure: '*It was the most complex… the bright colours and the fact that there is a lot more going on*'. Least preferable to encounter were the '*plain green*' grasses and ferns that lacked structure and variety in colour, described as '*nondescript…the leaves are not really an interesting shape, they're just like a child draws a leaf*' and '*disinteresting and more weed-like*'. These perspectives were linked to expectations of the natural environment: '*you want to see sort of how the plants are naturally competing with each other*', and the desire to see a variety of colours and shapes that would add interest when experiencing woodland.

3.4.3 | Appealing to the senses

Sensory interactions with species were the subject of this factor, particularly smell, texture and edibility (Table S4). These were both positive: '*if it smells of garlic then I think that's a good thing*' or '*you can eat it which is always a good thing about it'* and negative: '*doesn't feel nice to touch. It's sticky*'. Reference to touch comprised intrigue as to how the organism would feel or react: '*I like that fern…when you touch it, it curls back up on itself*', as well as avoidance of perceived threats: '*I think any fungi that grows off tree is dangerous, you shouldn't touch it*'. Participants also spoke about the provisioning services of plants and fungi. '*Blackberry picking*' was frequently articulated in terms of being a happy childhood activity.

3.5 | Shared perspectives across Q sets

The four Q sets provided an insight into shared perspectives across a range of attributes. However, the participants did not articulate or respond to the attributes uniformly across the four broad taxonomic groups. Some overlap did exist, for example regarding how vertebrates and trees characterise woodland, but the shared perspectives mainly focused on divergent biodiversity attributes. For instance, the discussions for understorey plants and fungi were heavily focused on colour, yet this attribute received little attention in other Q sets. Likewise, the importance placed on the purpose and function of invertebrates was not apparent for the other Q sets. The same attributes of biodiversity are therefore not consistently related to or talked about by the public, across broad taxonomic groups.

While the Q sorts were a highly visual activity, the discussions captured a diversity of emotions, anthropomorphisms and associations. Notable cross-cutting perspectives emerged from the data. Participants spoke of associations that transcended physical properties of attributes, linking perspectives with culture. These were in association with a variety of cultural influences, such as literature: '*reminds me of stories, like The Animals of Farthing Wood*', cinema: *'deer…they're just really, really nice…I remember crying my eyes out when Bambi's Mum got shot*', and gaming: '*my favourite just because it was channelling some Super Mario vibes*'. Notably, fairies were strongly associated with woodland attributes: '*I just imagine all the fairies that dance round them*'.

Memories and reminders featured strongly in a number of ways, for example, '*I really like that plant because it reminds me of things I did in childhood*' or '*violets…They remind me of childhood, eating sweets*'. For some participants, the associations were symbolic of a place: '*I get the feeling of Hampstead Heath, top of the hill, and you see the city behind and the sky*' or of a person: '*They were my Grandad's favourite bird when I was growing up, they are very symbolic to me*' and '*we used to spend time with my Nan and she'd have a butterfly book. So in the summer we'd look out and we'd identify the butterflies. It's just a really, really lovely memory for me*'. Many participants indicated that childhood memories of woodlands were strong and positive, articulated as a time of imagination and adventures. Nonetheless, some participants also conveyed expectations of what a woodland encounter should be like: *'I think you get this idea as a child that the woods are full of creatures, but in reality you go out and you don't really see them*'.

Using images to elicit comments about a particular phenomenon provides one means of stimulating perspectives based on an individual's recollections of previous experiences, as these are more easily accessed through visual rather than verbal means (Sherren et al., 2010). This could well account for many of the discussions

being framed as memories or stories. Episodic memories are not completely understood, but it is believed that emotion plays a key role in their formation (Colman, 2015) which, in turn, influences cognitive function (Tyng et al., 2017). Indeed, the brain relies on perceptual memory to interpret the environment (Colman, 2015). It is therefore likely that certain attributes in the Q set images act as prompts for memories and emotions that may not be retrievable with free recall. Some participants found their preferences to encounter challenging to communicate, expressing them as unqualified judgements, as exemplified by the following: '*It's more of a feel, a feeling, rather than anything else. It's hard to describe really, I don't know*'. Some descriptions were framed within metaphors, such as '*ferns…they're ancient things, just fossils, ferns, furled ferns*' and '*bluebells…when they're out in full bloom, you've got a massive carpet*'. Metaphors are used as a tool for understanding and influencing how we conceptualise meanings (Ball, 2011). This means that they are not just a matter of language, but are things we live by and have a function in cultural reality (Lakoff & Johnson, 2008; Talebinejad & Dastjerdi, 2005).

4 | CONCLUSION

If we are to move beyond generalisations about human–nature interactions and the importance of 'green space', we need gain a much richer understanding of how the public relate to biodiversity, the living components of nature. Nature is often presented in research, policy and practice as a setting (e.g. urban park, nature reserve) or theatre of activity (e.g. recreation, tourism) with minimal engagement with particular attributes of biodiversity. Here, we have taken an exploratory approach and unpacked which attributes of biodiversity people respond to, both positively and negatively. Discussions were wide ranging, with shared perspectives emerging from a variety of influences (e.g. experience, culture, media) and senses. Visual characteristics (e.g. colour, aesthetic appeal, size, shape) were dominant, which is to be expected as we used image-based stimuli in our Q methodology. However, people also talked about smells, touch and taste. Our work also highlights that we need to think beyond just ecosystem services and the implicit assumption that nature and biodiversity are beneficial for people. The shared perspectives held by British public for biodiversity were not ubiquitously positive. Additionally, they often transcended specific species or taxonomic groups, with only a few mapping onto objective measures and dimensions that researchers use to describe and categorise biodiversity (e.g. rarity, ecosystem service provision).

While British woodlands were our study system, our findings illustrate that the public quickly reference perceptions and experiences that were external to this habitat type. These included people's interactions with biodiversity in their everyday lives (e.g. near to home), as well as sometimes deep-rooted personal, societal and cultural associations. Moving forward, therefore, studies that investigate people's preferences for nature and biodiversity in a specific setting need to be aware that their findings could be heavily affected by influences external to the research study system. Indeed, a nuanced understanding of human–nature interactions may not be achievable if studies restrict possible explanations to a particular location or habitat. The richness and diversity of results that emerged from this exploratory study demonstrate the value of participant-led methods and discussion, which can reveal subjective viewpoints that would not become apparent via methods that are solely driven by researcher-led activities. Here we provide a fuller understanding of the ways in which people interact with, respond to and talk about biodiversity, providing important insights into how we can better engage people with nature and, more specifically, biodiversity across all realms of research, policy and practice.

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CONFLICT OF INTEREST

R.D.F. is a Lead Editor of People and Nature. M.D. and K.N.I. are Associate Editors of People and Nature. They were not involved in the peer review or decision making process.

AUTHORS' CONTRIBUTIONS

Z.G.D. and M.D. conceived the idea; G.E.A., M.D., K.N.I., P.R.M., R.D.F. and Z.G.D. designed the methodology; G.E.A. analysed the data; G.E.A. led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

DATA AVAILABILITY STATEMENT

The Q sort data are available via the Kent Data Repository (KDR) https://doi.org/10.22024/UniKent/01.01.174.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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