Beauty, memories and symbolic meaning: Swedish student teachers’ views of their favourite plant and animal

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ABSTRACT
In the twenty years since the first theory of ‘plant blindness’ was published much discussion has ensued concerning this phenomenon. More recent research, not only demonstrates that humans appear to favour animals over plants but also indicates a preference for mammals with forward-facing eyes. For this paper, we analysed answers to an online survey conducted with 202 student primary teachers in Sweden collected over a period of two years. We focus on two open-ended questions concerning favourite plant and animal choices and motivations for these choices. Our intention in this study was not to contrast animal vs. plant, but rather to further explore differential appreciation of plants and animals. Our findings suggest that there are large variations regarding relationships with plants and that affective connections with plant-life are translated through expressions of beauty, symbolic meaning, emotions (life-long) memories, colour, smell and size, and that similar characteristics seem to attract humans to animals. Our results – in line with arguments presented in recent studies – strongly suggest that in biological education and conservation contexts we should rely more intentionally on cultural and personal factors, utilise pre-existing experience-based human-plant bonds, and in so doing reinforce human recognition and appreciation of plants.

KEYWORDS
Plant blindness; favourite organism; student teachers; education; survey

Introduction
Since Wandersee and Schussler first published their theory of ‘plant blindness’ (Wandersee and Schussler 1999, 2001), much discussion has ensued concerning this phenomenon (e.g., Balding and Williams 2016). ‘Plant blindness’ was initially introduced as a theoretical model by Wandersee and Schussler and has been defined as ‘the inability to see or notice the plants in one’s environment’ (Wandersee and Schussler 1999, 82). In their research overview Balding and Williams (2016), claim that ‘[a] number of studies provide evidence that humans have higher preference, superior recall, and visual detection of animals relative to plants.’ (1193). They argue that plant blindness is ‘common, but not inevitable’ (1192) and state that ‘although plant blindness has a foundation in biologically based patterns of perception and cognition, cultural factors play a significant role in determining whether a given individual notices and values plants’ (Balding and Williams 2016, 1194). In line with this, there are some indications that students’ interest in and affection for plants is often based on experiences of plants in their early childhood (Wandersee and Schussler 2001). Although Balas and Momsen (2014), in their experimental study of visual cognition of plants in relation to animals, found that plant blindness ‘may result in part from differences in the visual processing of plants versus animals’ (441), they state that...
rather than seeking answers to the question of ‘[w]hether plant blindness is normal and inevitable’ (442), educators should instead focus on learning opportunities that assist students to ‘compensate for and overcome their perceptual limitations’ (442).

According to Balding and Williams (2016), conservation initiatives are ‘biased against plants and toward mammals and birds’ (1193), in particular, large mammals with ‘forward facing eyes’ (1193). Similarly, Knight (2008) refers to previous studies showing that ‘characteristics of species such as size, phylogenetical similarity to humans, and the species capacity for feeling, thought and pain’ (Knight 2008, 95) were more important than aesthetics with regard to public support for endangered species. Nevertheless, in his investigation of 228 undergraduate students in an American university regarding their attitudes towards ten endangered animal species, Knight (2008) found a strong correlation between a positive aesthetic ranking and support for governmental protection of the animal, concluding that ‘aesthetics was significantly related to governmental protection of species.’ (Knight 2008, 102).

Various explorations of students’ preferences regarding plants and animals have been made. For example, Wandersee (1986) asked 136 high school students to list the science subjects that interested them most and ‘in order of importance to you’ (Wandersee 1986, 416). Apart from the fact that animals were mentioned more often than plants, it was noticed that ‘[t]here was less diversity among the responses assigned to the plant category and many students simply wrote the word “plant”’ (Wandersee 1986, 418). Kinchin (1999) investigated the preferences of 162 secondary-school girls regarding an animal (an insect – a wasp) vs. a small flowering plant (often considered a weed) and found that the animal (Mellitobia digitata) was clearly preferred over the plant (Arabidopsis thaliana). In their study of 327 university students’ recall of plant and animal images, Schussler and Olzak (2008) found that the degree to which the students recalled animals and plants was significantly ‘higher’ for animals than for plants (115).

Research attempts have also been made to explore different educational initiatives designed to prevent plant blindness and to increase students’ interest in plants (e.g. Strgar 2007; Fančovičová and Prokop 2011). In a study in which over 4000 children aged 8–16 participated (Lindemann-Matthies 2005), it was found that the students’ interest in wild plants increased after an educational programme focusing on wild plants in the nearby environment. Another project where students grew plants from a seed to a mature plant showed that students’ relationships with plants were strengthened (Krosnick, Baker and Moore 2018). Similar findings have been reported from a study (Nyberg and Sanders 2014), in which a delayed post-test, 6 months after the project, however, demonstrated that students’ increased interest appeared to be time-limited. Studies of children’s interest in botanic gardens have shown that some special characteristics of plants seem to draw children’s attention, such as smell, behaviours, colour and pattern, scale and floristic features (Sanders 2007). Others have found that utility plants can attract learners’ interest (Pany 2014). There have also been attempts to understand whether the use of anthropomorphic and teleological reasoning in biology education about plants and animals is favourable when it comes to an understanding of biological phenomena (Tamir and Zohar 1991). The authors conclude that anthropomorphic approaches to plants and animals in biology education are interpreted in diverse ways by the students in their study – 28 randomly selected high school students between the age of 15 and 17. Critically, their study found that most of the students, in their sample, ‘can distinguish between anthropomorphic formulations and factual explanations’ and that many of them ‘support anthropomorphic formulations as a means of making concepts and processes more comprehensible’ (Tamir and Zohar 1991, 65). More specifically, they found contrasting student interpretations in relation to attitudes to animal and plant behaviours, some of which appeared to relate to Aristotelian perceptions of the ‘psyches’ of animals and plants in relation to humans, i.e. humans at the top of the ladder followed closely by animals with plants being considered a lower, and inanimate, form of life (Tamir and Zohar 1991, 66).

Numerous authors highlight the need to address teaching and learning about plants (e.g. Hershey 2002; 2009; Balas and Momsen 2014; Nyberg and Sanders 2014; Balding and Williams 2016).
However, many of the reported studies on ‘plant blindness’ have focused on school children’s perceptions, as noted earlier. In contrast, this paper considers student teachers.

Our intention in this study was not to contrast animal vs. plant, but rather to further explore differential appreciation of plants and animals, previously suggested by Sanders (2004) and Lindemann-Matthies (2005). Sanders (2004) sought to offer her respondents open-ended questions concerning favourite plant choice rather than the binary option: which do you prefer, plant or animal? This was a deliberate strategy to step back from either/or questioning modes, which appear to limit deeper examination of human preferences. Thus, our aim in this study was to investigate student teachers’ motivation for favouring a particular animal, among all animals, and a particular plant, among all plants. In this way we were able to examine:

- if favourite animal characteristics resemble those suggested in the plant blindness literature.
- an understanding of the phenomenon ‘plant blindness’ in a Swedish cultural context.

The results presented here are part of a three-year interdisciplinary research project, ‘Beyond Plant Blindness – Seeing the importance of plants for a sustainable world’, funded 2015–2017 by the Swedish Research Council, in which we conducted a range of studies in diverse settings not only targeting plants in themselves, but also how humans interact with the ‘plantness’ of the plants (Darley 1990). Hence, we used the term ‘beyond’ in order ‘to motivate teaching and learning that can move beyond plant blindness towards experiences in which teachers and learners see the importance of plants for a sustainable world’. The research is carried out mostly in the context of teacher education in one of the largest universities in Sweden. The data collection is thus conducted within a Scandinavian context, with substantial differences between winter and summer seasons. Winter is dark and cold. Midwinter has only a few sun hours per day, whereas summer is filled with light due to many sun hours.

For this paper, we examine answers to an online survey (using the software tool SurveyMonkey) conducted with 202 student teachers in Sweden collected at seven occasions with different student teachers over a period of 2 years. Twenty-three questions were asked in the survey and the questions were divided into sections covering both affective aspects, conceptual knowledge regarding plants’ reproduction, as well as knowledge regarding basic botanical systematics, such as whether a tree or a moss is a plant. Here we focus on two open-ended questions concerning the student teachers’ favourite plants and favourite animals, and the motivations for these choices. Examining Swedish student teachers’ perceptions of animals and plants will add to the knowledge base regarding educational challenges and possibilities when it comes to ‘plant blindness’. The outcomes of our study can be seen as one basis for developing ‘ways to implement and systematically evaluate approaches that encourage identification with and empathy toward plants’ (Balding and Williams 2016). The reason for choosing primary teacher students for our study was that this group, once qualified, will impact on future biology education practice in schools. Therefore, we need to know more about their points of departure in relation to teaching about plants and animals. In the Swedish National Curriculum for the compulsory school (Swedish National Agency for Education 2011) grades 1–3 (ages 7–9) it is clearly stated that the pupils shall learn about both about ‘seasonal changes in nature’ and about ‘animals and plants in the local environment and how they can be categorised, grouped and their species determined, and also the names of some common species’ (167) and for grades 4–6 (ages 10–12) about ‘relationships between different organisms and the names of common species’ (168).

Methods

Data were collected through an online survey tool (Survey Monkey) on five occasions in January and two occasions in September in seven different student groups over a period of 2 years. The research participants were 202 primary school student teachers, that, at the time of the data collection, had recently started a course addressing science teaching for ages 7–9 (159 student
teachers – a compulsory course) and for ages 10–12 (43 student teachers – an elective course). Out of 202 students, 148 (73,3%) participated during their spring academic term, and 54 (26,7%) during their autumn term. Part of the science teaching course focuses on ways to teach about animals and plants, but at the time of the data collection, the students had been following the course for only one or two weeks, and thus had little exposure to the course content other than the introduction. The students gave their written consent to participate and were informed that the research concerned perceptions of animals and plants in the environment. For this paper, we focus on two of the open-ended questions, which were: ‘What is your favourite animal – and why is it your favourite animal?’ and ‘What is your favourite plant – and why is it your favourite plant?’, in that order. All of the participants answered the favourite plant related question and all but one answered the favourite animal related question.

The role of open-ended questions
Arnon and Reichel (2009) found that their open-ended questions were more effective in revealing participants’ ‘authentic perceptions and beliefs’ (191) than their closed questions, and that binary coding of qualitative data enabled suitable descriptive and inferential statistical procedures. Similarly, Reja et al. (2003) argue that the advantage of open-ended questions is that they allow for discovering responses that individuals give spontaneously, thus avoiding the bias resulting from suggesting the answers to individuals, which is typical of close-ended questions.

Analysis
Coding was conducted by three researchers, two teacher educators specialised in biology teaching, both with a background in ecology, and one psychologist. Only codes agreed upon by all of the researchers were accepted into the coding matrix.

For each question, the answers were first coded regarding favourite animal/plant and thereafter regarding the reasons for the choice. The categories were not defined in advance, but emerged as a result of a qualitative way of analysing the answers, in accordance with the procedure called ‘open coding’ by Cohen, Manion and Morrison (2011, 539). By repeatedly reading the answers given and comparing them with theoretically grounded aspects of relationships between humans and animals (e.g. Knight 2008; Balding and Williams 2016) and from the literature regarding humans and plants (e.g. Sanders 2007; Balding and Williams 2016), the different categories were defined. As described in Andersson and Wallin (2000), ‘[the] categories emerge by a process of hypothesizing them and checking them against actual answers’ (1100). A more detailed description of how such categories can be formed is given in Andersson and Wallin (2000). The definitive categorisation of the reasons for the choice of animals or plants was carried out by a minimum of two researchers, which always included one of the biologists and the psychologist. After categorisation was finalised, all answers were revisited and the categorisation was ‘cross-checked’ within the research team.

The categories for reasons for choosing plants were constructed first. For the categorisation of the motivations for choice of animal, we used the categories of the plants as a point of departure. Some of these categories turned out to be applicable to both the animal and plant related answers, and they were therefore retained, whereas some of the answers required new categories. Other categories were slightly changed but were still related. Some categories thus disappeared altogether (such as Smell, Shape and Taste), while new ones were created (such as Anthropomorphism, Behaviour and Ownership).

After the coding was carried out, the frequency analysis was performed using IBM SPSS 24.0.
Results

Favourite animal

The student teachers’ answers to the question about their favourite animal resulted in 50 categories of different animals (Figure 1 and Appendix 1). Ten students did not specify a favourite animal (‘Have none’), two answered that they did not like animals and one student stated both. Favourite animals mentioned by more than 10 students were Dog (58), Cat (45) and Horse (19). Domestic animals were thus in a majority among the answers. Of the remaining animal choices ocean species, such as Seal and Dolphin, as well as large African land mammals, such as Lion, Elephant and Giraffe were mentioned.

Reasons for choosing favourite animal were categorised into 24 categories (Figure 2). The most common reasons were categorised as relating to Anthropomorphism (N = 80), Beauty (N = 48), Behaviour (N = 48), Emotion (N = 47) and Memory or History with (N = 40). The reasons were assigned to more than one category when the meaning so required.

Almost three quarters (74.6%) of the students’ motivations were categorised in at least two categories. For example, the answer ‘Dolphins, because they are beautiful and seem to have fun’ was coded in three ways: as relating to Anthropomorphism, because they are given human features such as ‘seem to have fun’, as Beauty because they are called ‘beautiful’ and as Behaviour because of the behaviour: ‘have fun’. A motivation for favourite animal choice such as ‘Dog. I have a dog myself and it is my best friend! Gives so much love and accepts me just the way I am.’ Was categorised into five categories, as explained in Table 1.
The most common reason for choice of favourite animals (Figure 2) belongs to the category of Anthropomorphism (N = 80), including answers such as (‘Elephants. They are beautiful, wise and empathetic’, ‘Dog.// . . . // Gives so much love and accepts me just the way I am’). A number of the motivations categorised as Anthropomorphism are also categorised as Behaviour (29) and as

Table 1. Example of categories of reasons for choosing favourite animal, in which the reason for the category chosen is marked in bold.

| Category                           | Example                                                                 |
|------------------------------------|-------------------------------------------------------------------------|
| Anthropomorphism                   | - Dog. I have a dog myself and it is my best friend! **Gives so much love and accepts me** just the way I am. [Hund. Har själv en hund och det är min bästa vän! Ger så mycket kärlek och accepterar mig precis som jag är.] |
| Emotion                            | - Dog. I have a dog myself and it is my best friend! **Gives so much love** and accepts me just the way I am. |
| Memory or History with Ownership   | - Dog. **I have a dog myself** and it is my best friend! Gives so much love and accepts me just the way I am. |
| Companionship to humans            | - Dog. I have a dog myself and **it is my best friend!** Gives so much love and accepts me just the way I am. |
Furthermore, strong bonds with animals can be seen from other categories of answers, such as Emotion (47), Memory or history with (40), an explicit notion of Ownership (33), and liking the animals because of their Companionship to humans (31).

**Favourite plant**

Answers to the question about the choice of favourite plant were categorised in 74 categories of different plants (Figure 3 and Appendix 1). Three students did not specify a favourite plant (‘Have none’), one answered that he/she did not like plants and three students stated ‘Cannot choose’. Favourite plants mentioned by more than 10 students were Tulip (21), Rose (20), Orchid (16) and Wood Anemone (12). The names given were both named plants such as Oak, Heather, Lilac, Dahlia and generic forms such as Tree, Bush and Flowers. Named plants mentioned were both wild plants and domestic plants.

The categorisation of motivations for the choice of favourite plant resulted in 22 categories (Figure 3). For two of the categories (Emotion and Symbolic meaning), subcategories were also created (Love and Season respectively). The answers were coded with more than one category code, when their meaning so required, e.g. ‘Wood anemone. It symbolises spring and a fresh start for me. When the wood anemone comes, the spring has come, it becomes lighter and lighter and warmer and warmer outside’ was coded as both Symbolic meaning, the subcategory Season, as Emotion and as Ecological aspect (Table 2). Over half the participants gave answers that were placed in at least two categories.

Most commonly mentioned reasons for the choice of favourite plant were answers categorised as Beauty, Symbolic meaning, Emotions, Memories or History with and specific aesthetic features – Colour, Smell, and Size. The frequencies of answers placed in each of the categories are presented in Figure 4.

**Beauty**, the most frequent motivation (94) was related to 42 different plants, most commonly Orchid (14), Rose (11), Tulip (8), Lily (8), Peony (7), and Oak (6). The notion of Beauty most commonly co-occurs with the answers categorised as Emotion (14, e.g. ‘I love lilies of the valley. They are incredibly beautiful with their bell-shaped flowers and the scent is lovely’), Colour (14, e.g. ‘Roses because they are beautiful and come in many different nice colours’), Size (10, e.g. ‘Oak – big, beautiful trees’), Nice smell (11, e.g. ‘Honeysuckle because it smells incredibly good and it is beautiful’), Symbolic meaning (10, e.g. ‘Honeysuckle. Because they are beautiful and remind me of my favourite season’), and Memory or history with (9, e.g. ‘Oak. They are huge and were excellent climbing trees when I was younger’).

**Symbolic meaning**, the second most frequent motivation (N = 44), includes the subcategory Season (N = 32). In total, 22 different types of plants were selected by the students for their Symbolic meaning, most commonly Wood anemone (11) and Tulip (10), in all cases associated with the season of spring. Among the motivations categorised as Symbolic meaning but not in the subcategory Season, Rose is the most frequent plant-choice. For the category Emotion (N = 36), a common subcategory is Love (N = 8). Other frequent motivations for plant-choice are categorised as Memory (N = 31). These memories are often related to childhood (e.g. ‘Wood anemone. Because I picked

| Category               | Example                                                                 |
|-----------------------|-------------------------------------------------------------------------|
| **Symbolic meaning**  | - Wood anemone. **It symbolises spring** and a fresh start for me. When the wood anemone comes the spring has come, it becomes lighter and lighter and warmer and warmer outside. (Vitsippan. Den symboliserar vår och nystart för mig. När vitsippan kommer är våren i full gång, det blir ljusare och ljuvare och varmare ute.) |
| **Season**            | - Wood anemone. It symbolises spring and a fresh start for me. When the wood anemone comes the spring has come, it becomes lighter and lighter and warmer and warmer outside. |
| **Emotion**           | - Wood anemone. It symbolises spring and a fresh start for me. When the wood anemone comes the spring has come, it becomes lighter and lighter and warmer and warmer outside. |
| **Ecological aspects**| - Wood anemone. It symbolises spring and a fresh start for me. When the wood anemone comes the spring has come, it becomes lighter and lighter and warmer and warmer outside. |
them with my mum when I was small, and also because they smell good and begin spring."

Colour is mentioned as a reason for the choice of the favourite plant in 27 of the answers.

No differences were found in the percentage of students who explicitly mentioned season in their answers between spring term students (16,2% mentioned season) and autumn term students (14,8% mentioned season). We also compared the percentage of students in both groups that

Figure 3. Most frequent answers to the question 'What is your favourite plant?' All other plants (N = 47) were chosen only once.
mentioned typical spring flowers (Cherry, Tulip, Wood Anemone, Snowdrop, Dandelions, Lily of the Valley, Daisy, Lilac) as their favourite, and no significant difference, tested with a chi-2 test, was found for any of the plants. There is, however, a slight tendency, that Tulip (mentioned by 12.8% of students at the beginning of the spring term, compared to 3.7% students in autumn) and Wood Anemone (mentioned by 6.8% of students at the beginning of the spring term, compared to 3.7% students in autumn) are mentioned more often by spring term students, i.e. for those students that conducted the survey in January, when it is still dark and cold compared to students that answered the survey in September, when the days are still quite warm and long in Sweden.

**Similarities and differences regarding reasons for plant and animal choice**

For both plants and animals, reasons for plant choice were categorised as relating to Beauty, Emotions, Memory or History with, Fascination, Size, Ecological aspects, Symbolic meaning, Variety, Colour, Usefulness, Easy to care for, Food and Age. Comparisons between the categories for both plant and animal choice, show to some extent a similar pattern regarding the number of

![Diagram showing frequencies of answers to the question 'Why is it your favourite plant?' by category, out of 183 students that mentioned at least one reason.](image-url)
answers relating to each category (Figures 2 and 4). However, the category Symbolic meaning is clearly more related to plant choice than to animal choice and the category Anthropomorphism is not at all present among the motivations for plant choice. The most common motivation for favourite plant choice is Beauty, whereas the most common motivation for favourite animal choice is Anthropomorphism.

Beauty is, however, also present regarding animal choice and is here the second most frequent motivation, together with Behaviour and Emotion whereas Symbolic meaning is the second most frequent reason for favourite plant choice.

Summary of results

These results demonstrate that among the animals, domestic animals, such as Dog, Cat and Horse, are preferred, although 50 different animals are mentioned as favourite animals. The diversity among the animals mentioned is relatively low to that of the plants and all the chosen animals are vertebrates, and almost all are mammals. Anthropomorphic features dominate as reasons for the choice of favourite animal, but Beauty, Behaviour and Emotional aspects, as well as Companionship and Memories or history with the chosen favourite animal are also important features. Regarding plants, there is a large variation in plants chosen (74 different types). Aesthetic features dominate as motivations for choice of favourite plants, but next to Beauty, the category Symbolic meaning is the largest, in which most students (32 out of 44) mention different aspects of the subcategory Season, with the most common motivation that the plant chosen is a herald of spring.

Discussion

As stated in our introduction, our intention in this study was not to contrast animals with plants, but rather to explore preferences for both. We investigated student teachers’ motivations for favouring a particular animal, among all animals, and a particular plant, among all plants, applying parallel questions related to animals and plants with the same participants, compared the answers related to animals and plants and explored their similarities and differences. In this way, we were able to examine whether the reasons for favouring both plants and animals resemble those suggested in the plant-blindness literature (e.g. Balding and Williams 2016). We also focused on gaining an understanding of the phenomenon ‘plant blindness’ in a Swedish cultural context.

As previously shown, a large number of the animals mentioned as favourites could be said to belong to the category of mammal species having large bodies and forward-facing eyes. (34 out of 50). This is in line with previous research (mentioned in Balding and Williams 2016, 1193) on types of animals particularly attractive to conservation initiatives. The large number of reasons given for animal-choice in our study belonging to the category Anthropomorphism (N = 80), in combination with the relatively large number of motivations categorised as Behaviour (N = 48), indicates that anthropomorphic features of animals have a direct and consistent effect on human’s preference for a particular animal. This corresponds to the findings by Tamir and Zohar (1991) that most students in their study attributed ‘at least some human purposeful behaviour to animals’ (66), but that this was not the case regarding plants, thus their study, like ours, found a concentration of anthropomorphic attitudes to animals rather than to plants. One of the previously established (Knight 2008) characteristics that attracts humans to animals – Beauty (‘aesthetics’ in Knight’s terminology) – is mentioned in our study 48 times as a reason for choice of favourite animal. Furthermore, strong bonds with animals can be seen from answers categorised as Emotion, Memory or history with, explicit notions of Ownership, and Companionship to humans.

Our results show that that the number of students who do not have a favourite animal or plant, or do not like plants/animals is almost the same for plants and animals (11/12). Furthermore, the variety of answers given to favourite plant and favourite animal questions suggests that students in this study recall a greater variety of plants (74) compared to animals.
These answers challenge the proposal that people do not appreciate or recognise plants, or at least do so less strongly compared to animals. Indeed, it suggests that, in our student teacher group, there was greater limitation on appreciation of animal diversity. The variety of plants mentioned in our study thus opposes the findings by Wandersee (1986) regarding the lower diversity of plants than animals when high school students were asked to list science subjects of interest to them.

Although nearly the same number of categories of reasons for favouring animals (24) and plants (22) were found in our study, predominant reasons for favouring animals and plants differ to some extent. Aesthetical features (Beauty) dominate for choice of favourite plant vs. anthropomorphic features for choice of favourite animal. However, some of the reasons occur in both groups. For example, reasons related to emotions are present in both plant (36) and animal (47) related answers, as well as motivations that encompass individual, personal experience with, i.e. the category Memory or history with related to plant (31) and to animal (40). A category of motivation present in both groups is Beauty, as the most common for plants (94), and second most common for animals (48), along with Behaviour and Emotion. If a connection can be assumed between choosing an animal as a favourite and supporting its protection, our data – with ‘Beauty’ as the second largest motive for favourite animal choice – can be said to support previous research showing that aesthetic attractiveness is an important determinant of support for protecting animal species (Knight 2008).

Our analyses suggest that appreciation of both animals and plants is present among the student teachers in our study. The students produce variable, rich, often detailed answers when spontaneously describing the reasons for their favourite plant/animal choice and the students’ answers represent complex and well-established relationships with both their favourite animal and plant.

While animals inevitably possess features that are lacking in plants and that attract humans such as ‘phylogenetical similarity to humans’ (Knight 2008, 95), our data show that some unique features of plants should be given additional attention. For example, plants are to a significant extent affiliated with Symbolic meaning, universally within the culture and for the individual, such as Wood anemone, which in Sweden is perceived as a herald of spring.

The notion that cultural factors are important is supported by our findings for both for plants and animals; the category Memory or history with is one of the most common reasons given for choosing both favourite plant (31) and favourite animal (40). The data are therefore in line with Balding and Williams’ notion that cultural factors play a role when it comes to forming relationships between humans and plants (Balding and Williams 2016). If these are to some extent culturally shaped, and our data appear to suggest so, we can assume that they also have potential for being educationally shaped. Thus human-plant relationships, just like human-animal relationships, seem to rely strongly on individual, personal experiences that can be used as educational resources during teaching and learning experiences. Our data also support the conclusion made by Balding and Williams (2016) that in order to promote plant conservation, it is important to encourage ‘opportunities for people to connect with plants emotionally and cognitively’ (1195), since ‘education or information alone typically does not result in increased conservation behaviour’ (1195). Although our work in some ways reflects the findings by Tamir and Zohar (1991) pertaining to a concentration of anthropomorphic attitudes to animals rather than to plants, we note that our teacher students expressed a rich repertoire of relationships with plants. These were however oriented around aesthetics and symbolic memory which expressed a relationship with, and knowledge of, a diverse range of plant species.

**Limits and recommendations**

One often-mentioned disadvantage of the use of open-ended questions is the need for extensive coding, especially if medium to large size samples are analysed, but given the richness of answers and deeper understanding of investigated concepts in our research, this use has proven to be worthwhile. Based on previous research (e.g. Reja et al. 2003) it could have been expected that open-ended questions in a web questionnaire would produce a substantial percentage of missing values or a large
number of inadequate answers. However, this was not the case. All students replied to the plant-related question and all but one replied to the animal-related question. Furthermore, all answers were appropriate to the questions asked and could be coded within the coding matrix. This outcome was probably at least partially a consequence of the questionnaire being context-relevant, in that the students had just started a science education course. The categories developed in this study for plant and animal choice could serve as a basis for close-ended questionnaires and their application in larger-scale research within different contexts and with various target groups, such as school children, teachers in other subjects, or the general population.

**Conclusion**

In our study student teachers expressed a greater diversity of plants nominated as favourite than animals. This suggests that, rather than bemoaning the fact that flowers do not have faces and forward-facing eyes, our teacher students are drawn to a rich range of plant forms, albeit most of which are seed plants with conspicuous flowers. Our findings thus show that there is much potential for building human-plant relationships. However, critically, these findings demonstrate that the majority of the answers stem from either culturally or personally shaped experiences: few students recall an educational experience or setting when presenting motivation for their favourite specimen, be it animal or plant. This is to some extent surprising, since the Swedish curriculum clearly states that students in primary school should learn about both plants, animals and other organisms. Perhaps this is too long ago in the education of these student teachers – or maybe teaching about species has been lacking in their recent educational experiences. This finding clearly calls for a closer examination of teacher education to investigate the extent to which we prepare our teacher students for the specific task of understanding the biological importance of plants.

Our results – in line with arguments presented by Balding and Williams (2016) – therefore strongly suggest that in biological education and conservation contexts we should rely more intentionally on cultural and personal factors, utilise pre-existing experience-based human-plant bonds, as points of departure for reinforcing recognition and appreciation of plants within educational contexts.

**Note**

1. [https://idpp.gu.se/english/Research/research_projects/beyond-plant-blindness-seeing-the-importance-of-plants-for-a-sustainable-world/](https://idpp.gu.se/english/Research/research_projects/beyond-plant-blindness-seeing-the-importance-of-plants-for-a-sustainable-world/).

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References

Andersson, B., and A. Wallin. 2000. “Students’ Understanding of the Greenhouse Effect, Social Consequences of Reducing CO₂ Emissions and Why Ozone Layer Depletion Is a Problem.” Journal of Research in Science Teaching 37 (10): 1096–1111. doi:10.1002/1098-2736(20001223):10<1096::AID-TEA4>3.0.CO;2-8.

Arnon, S., and N. Reichel. 2009. “Closed and Open-ended Question Tools in a Telephone Survey about ‘the Good Teacher’: An Example of a Mixed Method Study.” Journal of Mixed Methods Research 3 (2): 172–196. doi:10.1177/155868908331036.

Baird, J. H., R. Lazarowitz, and V. Allman. 1984. “Science Choices and Preferences of Middle and Secondary School Students in Utah.” Journal of Research in Science Teaching 21 (1): 47–54. https://doi.org/10.1002/tea.3660210106.

Balas, B., and J. L. Mønsen. 2014. “Attention “blinks” Differently for Plants and Animals.” CBE – Life Sciences Education 13 (3): 437–443. doi:10.1187/cbe.14-05-0080.

Balding, M., and K. J. H. Williams. 2016. “Plant Blindness and the Implications for Plant Conservation.” Conservation Biology 30 (6): 1192–1199. doi:10.1111/cobi.12738.

Cohen, L., L. Manion, and K. Morrison. 2011. Research Methods in Education. 7th ed. Milton Park, Abingdon, Oxford, England: Routledge.

Darley, W. M. 1990. “The Essence of 'Plantness'.” The American Biology Teacher 52 (6): 354–357. doi:10.2307/4449132.

Fančovičová, J., and P. Prokop. 2011. “Plants Have a Chance: Outdoor Educational Programmes Alter Students’ Knowledge and Attitudes Towards Plants.” Environmental Education Research 17 (4): 537–551. doi:10.1080/13504622.2010.545874.

Hershey, D. 2002. “Plant Blindness: ‘We Have Met the Enemy and He Is Us’.” Plant Science Bulletin 48: 78–84.

Kinchin, I. M. 1999. “Investigating Secondary-School Girls’ Preferences for Animals or Plants: a Simple ‘Head-to-head’ Comparison Using Two Unfamiliarorganisms.” Journal of Biological Education 33 (2): 95–99.

Knight, A. J. 2008. “‘bats, Snakes and Spiders, Oh My!’ How Aesthetic and Negativistic Attitudes, and Other Concepts Predict Support for Species Protection.” Journal of Environmental Psychology 28: 94–103. doi:10.1016/j.jenvp.2007.10.001.

Krosnick, S.E., J.C. Baker, and K. R. Moore. 2018. “The Pet Plant Project: Treating Plant Blindness by Making Plants Personal.” The American Biology Teacher 80 (5): 339–345. doi:10.1525/abt.2018.80.5.339.

Lindemann-Matthies, P. 2005. “‘lovable’ Mammals and ‘lifeless’ Plants: How Children’s Interest in Common Local Organisms Can Be Enhanced through Observation of Nature.” International Journal of Science Education 27 (6): 655–677. doi:10.1080/0950069050038116.

Nyberg, E., and D. Sanders. 2014. “Drawing Attention to the ‘Green Side of Life’.” Journal of Biological Education 48 (3): 142–153. doi:10.1080/00219266.2013.849282.

Pany, P. 2014. “Students’ Interest in Useful Plants: a Potential Key to Counteract Plant Blindness.” Plant Science Bulletin 60 (1): 18–27. doi:10.3732/pbs.1300006.

Reja, U., K. Lozar Manfreda, V. Hlebec, and V. Vehovar. 2003. “Open-ended Vs. Closed-ended Questions in Web Questionnaires.” In Developments in Applied Statistics, edited by A. Ferligoj and A. Mrvar, 159–177. Ljubljana, Slovenia: FDV.

Sanders, D. L. 2004. “Botanic gardens: ‘Walled, stranded arks’ or environments for learning?” Unpublished doctoral thesis, Sussex University, U.K.

Sanders, D. L. 2007. “Making Public the Private Life of Plants: The Contribution of Informal Learning Environments.” International Journal of Science Education 29 (10): 1209–1228. doi:10.1080/09500690600951549.

Schussler, E. E., and L. A. Olzak. 2008. “It’s Not Easy Being Green: Student Recall of Plant and Animal Images.” Journal of Biological Education 42 (3): 112–118. doi:10.1080/00219266.2008.9656123.

Strgar, J. 2007. “Increasing the Interest of Students in Plants.” Journal of Biological Education 42 (1): 19–23. doi:10.1080/00219266.2007.9656102.

Swedish National Agency for Education. 2011. “Curriculum for the Compulsory School System, the Pre-school Class and the Recreation Centre (revised 2018).” Accessed 28 April 2019. https://www.skolverket.se/publikationsserier/styrdokument/2018/curriculum-for-the-compulsory-school-preschool-class-and-school-age-educare-revised-2018?id=3984

Tamir, P., and A. Zohar. 1991. “Anthropomorphism and Teleology in Reasoning about Biological Phenomena.” Science Education 75 (1): 57–67. doi:10.1002/(ISSN)1098-237X.
Appendix

Plants mentioned once

Amaryllis, Anemone, Apple, Trees, Avocado, Basil, Beech, Beetroot, Berry, Bluebell, Blueberry, Bonsai, Cannabis, Carnations, Chilli, Coriander, Cucumber, Daisy, Dandelions, Elderberry, Flowers, Eucalyptus, Fern, Forget-me-not, Geranium, Gerbera, Ginger, Grape Tree, Primrose, Hearts, Hop, Ivy, Jasmine, Catsfoot, Lemon, Lupin, Monstera, Moss, Parsley, Peppermint, Poinsettia, Ranunculus, Rhubarb, Mother-in-law’s-tongue, Snowdrop, Thistle, Tufted Vetch, Wild Pansy, Wild Raspberry.

Animals mentioned once

Bear, Blackbird, Blue whale, Blue-winged Chestnut-fronted Macaw, Butterfly, Camel, Cow, Crocodile, Crow Bird, Eagle, Eel, Falcon, Fish, Fox, Goat, Guinea Pig, Hedgehog, Highland Cattle, Humboldt Penguin, Jackdaw, Leopard, Lizard, Mink, Monkey, Musk Ox, Ostrich, Parrot, Penguin, Pig, Squirrel, Turtle, Wild boar.