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Development and Initial Psychometric Assessment of the Plant Attitude Questionnaire

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Abstract Plants are integral parts of ecosystems which determine life on Earth. People's attitudes toward them are however, largely overlooked. Here we present initial psychometric assessment of self-constructed Plant Attitude Scale (PAS) that was administered to a sample of 310 Slovakian students living in rural areas aged 10–15 years. The final version of PAS consists from 29 Likert-scale items that were loaded to four distinct dimensions (Interest, Importance, Urban trees and Utilization). Mean scores revealed that Slovakian students lack positive attitudes toward plants and that gender had no effect on their mean attitude scores. Living in a family with a garden was associated with a more positive attitude toward plants. Further correlative research on diverse samples containing urban children and experimental research examining the impact of gardening in schools on student attitudes toward plants is required.

Keywords Attitudes · Gardening · Plants · Psychometric assessment

Introduction

Plants provide us with the life-sustaining elements to survive on this planet (Lewington 1990). Plants can also provide humans with food stuffs used for things other than energy, paper, wood, clothes, medicines and many other products. They are very important in the environmental sphere insuring shade, noise abatement, erosion prevention, windbreaks. Plants also provide inspiration being used as decorations, attractions, and for hobbies (Kaufman and Carlson 1990).

Agriculture first began about 10,000 years ago in the fertile crescent of the Near East, where people cultivated wheat and barley (Crawford 1992). The development of agriculture led to enormous development in human cultures, as well as a growth in the human population. Habitat destruction (Diamond 1989; Wilson 1992), climate change (Root et al. 2003; Thomas et al. 2004) and the introduction of exotic species (Fritts and Rodda 1998) are contributing to declines in plant diversity. These decreases in plant diversity are primarily caused by human beings. As such, it should be humans who are responsible for the protection and recovery of the Earth's threatened diversity.

It is believed that positive changes in peoples' attitudes towards the environment are crucial for improving the quality of the natural environment and preserving global biodiversity (Kuhlemeier et al. 1999), mainly because attitudes are associated with behaviours (Kraus 1995; Glasman and Albarracín 2006). Most research into this area has focused on people's attitudes toward animals (e.g. Kellert 1985, 1993; Herzog and Burghardt 1988; Serpell 2004), people's views of plants, major components of natural ecosystems, have been largely overlooked. Plants are seen by people as being less important than animals (Wandersee 1986; Martín-López et al. 2007; Schussler and Olzak 2008) most probably because they lack movement like most animals (Kinchin 1999). There is evidence that girls appreciate plants more than boys (Dawson 1983; Lohr et al. 2004; Hong et al. 1998; Gatt et al. 2007; Prokop et al. 2007a, b; Schussler and Olzak 2008; but see Lindemann-Matthies

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2005), and that spending more time during childhood in gardening activities help people feel calmer and have increased personal value in adulthood (Lohr and Pearson-Mims 2005). Some research has shown that most people appreciate the value of trees in their live (Lohr et al. 2004). Wandersee and Schussler (2001) reasoned that plant characteristics such as their lack of movement and lack of face, their uniform colour and special grouping in large numbers, and the fact that they are typically not harmful, result in "plant blindness". This may result in people ignoring the plants around them and thus they having no perceived reason to learn their names (see Bebbington 2005) or show particular interest in them (Schussler and Olzak 2008).

The present study is focused on development and initial psychometric assessment of a plant attitude scale because, as far as we are aware, there are no questionnaires for specific measures of attitudes toward plants. The age of selected participants was 10–15 years. This age was chosen because, in the USA, Kellert (1985) found that this age was important in the development of children's cognitive abilities and their ecological awareness of the role of animals in their natural habitats it is likely that this is also true for their awareness of the role of plants. Thus, one of the aims of this paper was to identify Slovakian children's attitudes toward plants.

This paper explores the following questions: (1) Is having a garden associated with children's attitudes toward plants? (2) Are there any gender differences in attitudes toward plants?

Our Hypotheses Were:

1. Having a garden will be associated with a positive attitude towards plants. This hypothesis follows previous findings of Lohr and Pearson-Mims (2005) which suggest that childhood experiences with active gardening are associated with more positive attitudes toward plants.
2. Females will have a more positive attitude towards plants than males. This hypothesis is based on the fact that majority of works (except for Lindemann-Matthies 2005) found that females like plants more than males.

Methods

Participants for our study were recruited from two Slovakian rural elementary schools from villages inhabiting by about 5,000 citizens. These schools had between 200 and 250 children on the roll of the school. Overall 325 school pupils (150 boys and 175 girls) aged 10–15 years (mean = 12.70, SD = 1.40) from grades 5 (10/11 years), 6 (11/12 years), 7 (12/13 years), 8 (13/14 years) and 9 (14/15 years) participated in the study. Details about the biology curriculum in Slovakia are shown elsewhere (Prokop et al. 2007a). The selection of participants from these grades was not forced, rather it was based on teacher's willingness to administer questionnaires in selected schools. Participants were satisfied that the questionnaire was not a test, but was a non-judgmental attempt to examine their attitudes toward plants. No time limit was given for the completion of the questionnaires. To avoid social desirability in answering questions, the participants were not asked to give their names and so responses were anonymous (Streiner and Norman 1989).

A total of 95% of participants returned correctly completed questionnaires so analyses were based on 310 questionnaires. In order to examine factors influencing student's attitudes towards plants questionnaire included demographic characteristics such as age, gender and having a garden (yes/no). The age of children was controlled for (defined as covariate), because previous research revealed that attitudes toward biology depend on age of children, being highest in 6th graders (age 11/12) and lowest in 8th graders (age 13/14) (Prokop et al. 2007a, b).

Each student voluntarily completed the Plant Attitude Scale (PAS) which consisted of 45 self-constructed, five-point Likert-type items. Items were designed to measure three attitude dimensions (cognitive, behavioural and affective) (Eagly and Chaiken 1993). We specifically attempted to measure interest and enjoyment of plants (Interest), importance of plants for life of humans and other organisms (Importance), cost and benefits associated with urban trees (Urban trees) and material benefits from plants in industry (Utilisation). Theoretical framework for these dimensions followed a research by Lohr et al. (2004) and Lohr and Pearson-Mims (2005) who showed that (1) there is an inter-individual variability in interest in plants depending for example on childhood experiences with gardening (2) people consider plants as important for quality of our lives (3) plants in urban environment are perceived by people either positively (e.g., trees reduce noise) and negatively (e.g. trees cause allergies) and (4) people highly appreciate practical benefits from plants (e.g., the ability of trees to shade and cool surroundings).

The validity of the scale was established through review by three experts in biology education. All were asked (1) to evaluate which statements clearly indicate favourable or unfavourable attitudes toward plants and (2) to classify items to one of following four dimensions: Interest, Importance, Urban trees and Utilisation following a procedure of Salta and Tzougraki (2004). Revisions were carried out based on their comments and suggestions.

Each item was scored by participants using a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly

agree). Positive and negative items were used in the scale, while negative items were scored in the reverse order. Pupils filled the questionnaire out during a free lesson, they spent 30 min with breaks doing so. Teachers, who participated in this research, were instructed on how to fill out and work with the questionnaire.

Statistical Analyses

Two calculations were used to assure whether our data are appropriate for factor analysis. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. Large values for the KMO measure indicate that a factor analysis is appropriate. Another indicator of the strength of the relationship among variables is Bartlett's test of sphericity. This is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated.

Discriminant validity was calculated as the mean of correlation values of a dimension with other dimensions. Effects of categorical predictors (gender and having a garden) on mean attitude score of four dimensions (dependent variables) were calculated by the multivariate analysis of variance (MANCOVA). The age of each child was treated as a covariate, thus yielding tests uncontaminated by individual differences in age (Isaac and Michael 1972).

Results

Structure and Reliability of the Plant Attitude Scale (PAS)

The correlation matrix for the variables item 1–45 was computed. The Bartlett's test of sphericity gave a value of 3962.61 with a significance level <0.001, indicating the suitability of the factor model for the data under consideration. The value of Kaiser–Meyer–Olkin measure of sampling adequacy was 0.82, also indicating the appropriateness of the factor model (Salta and Tzougraki 2004).

Data from PAS were examined with factor analysis using Varimax rotation. Thirteen factors (PC1–PC13) with eighteen values >1.0 altogether explaining 59.9% of total variance of results were initially derived. We removed four items which loaded to more than one factor and eight items that loaded to factors that were represented by less than three items and thus could not be adequately interpreted. Final four items associated with criminality in parks were removed following suggestions of referees. Researchers disagree about the minimum loading that warrants item retention (Sharma 1996; Tabachnick and Fidell 2001). We used a liberal assignment criterion of at least 0.40 following similar research works (e.g. Thompson and Mintzes 2002; McKibbin et al. 2009), but no one item loaded below this value. A total of 29 items belonging to four factors, explaining 37% of the variance of results, were further statistically examined. The excluded items are available from the corresponding author upon request.

We calculated individual's scores for each factor by summing responses (if not stated otherwise) to the constituent items. Table 1 displays descriptive statistics for the four components and improved PAS. Table 2 displays the 29 items and component loadings.

Alpha reliabilities ranged between 0.70 and 0.83 for the dimensions. The alpha reliability for the total was 0.83. The values of discriminant validity ranged from −0.009 to 0.31. The values of alpha coefficients suggest that the instruments displayed have adequate internal consistency, while the low mean values of correlation coefficients between each dimension and the rest of the dimensions provided discriminant validity of the dimensions. These results support that the instrument was internally consistent and dimensions were highly independent from each for interpreting the data reported in the study.

Factors Influencing Children Attitudes toward Plants

As shown in Table 1, mean scores suggest that children's attitudes toward plants were neutral, but not unambiguously positive. The highest positive attitudes towards plants were shown in the *Importance* dimension followed by the means of the remaining dimensions (all of them can be considered neutral).

Multivariate analysis of variance (MANCOVA) revealed that there was a significant effect caused by age ($F_{(4,\ 302)} = 12.23$, $p < 0.001$, $\eta^2 = 0.14$) and by having a garden ($F_{(4,\ 302)} = 3.03$, $p = 0.02$, $\eta^2 = 0.04$) on mean attitude score. The effect of gender ($F_{(4,\ 302)} = 0.79$, $p = 0.54$, $\eta^2 = 0.01$) and interaction between categorical predictors (having garden × gender, $F_{(4,\ 302)} = 1.96$, $p = 0.10$, $\eta^2 = 0.03$) were not significant. Inspection of univariate results revealed that the effect of age was significant for three of the four dimensions: *Urban trees*, *Interest* and *Utilization*

Table 1 Descriptive for plant attitude scale dimensions of Slovakian children ($n = 310$)

Variable	Mean	SD	Min	Max	*N* of items	Cronbach's alpha
Importance	35.77	5.90	9.00	45.00	9	0.78
Urban trees	19.67	4.85	7.00	30.00	6	0.71
Interest	32.03	7.98	10.00	45.00	10	0.83
Utilization	12.96	3.58	4.00	20.00	4	0.70

Table 2 Factor loadings of the plant attitude scale (PAS)

Items	
Importance	
Life is impossible without plants	0.46
Trees are very important in a town centre because they provide cooling and shade	0.52
The town should take care of green space	0.57
Plants utilize the suns power	0.61
Plants produce oxygen	0.67
Pollution of the environment influences the life of plants	0.42
Plants are very important for medicine	0.52
Plants should be planted in towns to increase attractiveness of the environment	0.45
Plants also suffer from diseases	0.51
Eigenvalue	7.39
Explained variance (%)	18.32
Urban trees	
Plants should not be planted along streets because their leaves and fruits pollute	
Surroundings and fall down on cars	0.61
Plants should be taken away from the town because they impair electric lines	0.63
Plants should not be planted in town because they increase criminal behaviour	0.46
Plants should not be planted in towns because their roots destroy paths	0.57
Plants should not be planted close to business centres because they block signs	0.69
Plants in towns are a problem because they cause allergies	0.41
Eigenvalue	3.51
Explained variance (%)	8.56
Interest	
I am interested in reading books about plants	0.68
I would like to cultivate plants	0.66
I like visiting plant exhibitions	0.65
I enjoy house plants	0.68
I like spending time in the nature during my leisure time	0.58
I would like to have a small garden in the future	0.50
I am relaxed within plants	0.40
We should learn more about importance of plants in school	0.67
I like watching films about plants	0.67
I like walking in forest	0.45
Eigenvalue	2.47
Explained variance (%)	6.03
Utilization	
Clothes are made of plants	0.70
Furniture can be made from plants	0.66
Plants provide us with food	0.61
We utilize plants as fuel	0.67
Eigenvalue	1.77
Explained variance (%)	4.32

($F_{(1,\ 305)} = 22.37$, 16.00 and 5.69, respectively, all $p < 0.05$). Age-related changes were however inconsistent; while the mean Interest score decreased as the age of children increased, positive attitudes toward *Urban trees* and *Utilization* of plants increased with children age. Children living in families with a garden tended to have higher mean attitude scores in all dimensions, but this difference was significant only in the *Interest* dimension ($F_{(1,\ 305)} = 10.59$,

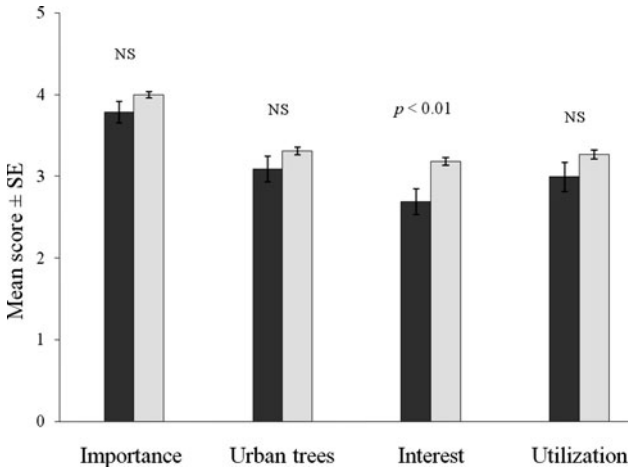

Fig. 1 Comparison of attitudes toward plants between children from families with (*white bars*, $n = 281$) and without a garden ($n = 29$). *NS* not statistically significant. Mean scores below and above 3.0 indicate negative and positive attitudes, respectively

$p = 0.001$, Fig. 1). Children from families without gardens had mean scores of Interest below the value of 3.0 which indicates a low interest toward plants. These results should however be interpreted with caution, because the subsample of children without gardens was relatively low (Fig. 1).

Discussion

This study shows the first attempt to examine student attitudes toward plants systematically. The initial psychometric analyses of a self-constructed Plant Attitude Scale showed satisfactory results: the scale is reliable and contains four distinct dimensions measuring student attitudes toward plants. According to mean attitude scores obtained from Slovakian children, attitudes toward plants are neither strongly positive, nor strongly negative. Most children showed rather "neutral" attitudes toward plants with mean scores of about 3.00. While the Importance of plants was relatively positively appreciated, interest in plants showed the lowest mean score compared with other dimensions (Fig. 1). This agrees with previous research which showed that plants are less preferred by people than animals (Wandersee 1986; Martín-López et al. 2007; Schussler and Olzak 2008).

The Effect of Gardening

Gardening and tree planting are effective in helping children to foster positive attitudes towards plants (Lohr and Pearson-Mims 2005). In agreement with this, we found an overall positive effect of living in families with gardens on students attitudes toward plants. Hypothesis 1 was therefore supported. This finding is also in line with research on the effects of keeping pets on children's attitudes: having pets at home is associated with more positive attitudes toward wild animals (Prokop and Tunnicliffe 2010).

This suggests that early contact of a child with nature is beneficial in building positive attitudes toward plants. It is worth noting that the strongest (and statistically significant) effect of gardening was found in the dimension "Interest" which suggests that gardening may stimulate student intrinsic, long-term interest in plants. Lohr and Pearson-Mims (2005) in their research showed that living near a garden during childhood was a significant predictor of interest in gardening in adulthood. Although the effect of gardening in our study was not very strong, this could be explained by the low sample of students living in families without a garden and by the absence of urban students who lacked gardens in the sample. However, the prime objective of our work was to make initial psychometric measures with the new PAS, not to make a comparison of students from urban and rural habitats. Future research should be focused on larger samples from more diverse age groups involving both urban and rural participants. Records of the degree of individuals' involvement in participation on gardening would allow analyses leading to a deeper understanding of impact of gardening on people's attitudes toward plants.

Significance of Gender

Although research suggests that studying plants or botany is more commonly preferred by females than by males (e.g. Lohr et al. 2004; Hong et al. 1998; Gatt et al. 2007; Prokop et al. 2007a, b; Schussler and Olzak 2008), we found no gender differences in student attitudes toward plants (see also Lindemann-Matthies 2005). Hypothesis 2 was therefore not supported. This result was not camouflaged by a different ratio of females living in families with gardens compared to males, because gender and garden interaction was not statistically significant. Although this result is hard to explain, it is possible that the sample of participants was too homogeneous and thus yielded similar male and female mean attitude scores. For example, students from urban habitats, who have generally greater awareness of environmental problems (Tikka et al. 2000; Tuncer et al. 2004), may be more limited in their access to gardens and/or wild plants. An urban environment would perhaps thus activate a desire amongst females to have plants or a garden more than it would in a rural environment, where gardens and opportunities for cultivation are commonly available. Another possibility is that gender differences failed to occur because students are mainly attracted by noticeable features of the plants such as colourful flowers, scent,

conspicuous fruits or general beauty (Tunnicliffe 2001; Lindemann-Matthies 2005), due to the fact that bright colouring signalled food sources for people throughout evolutionary time (Heerwagen and Orians 1993). It might be that gender differences occur only in the perception of plant beauty, but not in the overall perception of plants. Future research should further investigate the psychometric properties of the PAS, including examining its reliability, further dimensions (e.g., an aesthetic value of plants) and validity with data from larger, more diverse samples.

Conclusion

This research showed that plants are generally appreciated neutrally without marked positive attitudes by Slovakian students. Living in families with a garden was associated with more positive attitudes toward plants, but there were no gender differences. These results suggest that students do not sufficiently understand the role of plants in nature. Educational programmes that significantly increase appreciation of plants (e.g., Lindemann-Matthies 2005) are therefore required. It may be that the significance of urban trees is heavily underestimated by teachers, thus urban ecology requires increased coverage or that children's appreciation and understanding of the function of wild plants and urban trees differ; these issues require further research. Experimental research on the effects of gardening in schools on possible improvements of student attitudes toward plants is also needed. Currently, it is not clear how active gardening in schools (after controlling for childhood experiences and having a garden) influences children attitudes toward plants. Moreover, very few studies examined effects of outdoor programmes (Lindemann-Matthies 2005) or visits of botanic gardens on attitudes toward plants (Tunnicliffe 2001). The PAS would be very useful research instrument in such research works. The authors were currently used the PAS for examining effects of field-based education programme focused specifically to planting and gardening, which seems to be a promising area for utilization of this newly developed questionnaire in future research. Other future research might investigate relationships between attitudes and knowledge of plants. Recent research reveals mixed results for attitude—knowledge relationships in animals (Prokop et al. 2008), but little is known how these relationships work in plants. Finally, our study showed inconsistent, but significant effect of age on attitudes toward plants. Again, research showed mixed results for differences in attitudes toward animals between various age groups (Kaltenborn et al. 2006), but little is known about attitudes toward plants with respect to age of participants.

Our intention is not to assign all factors responsible for attitudes toward plants. Our goal in this research instead was to develop a psychometrically sound inventory of participants' perception of plants, to thereby encourage research in this important area. Identifying and assessing the specific factors associated with appreciation of plants can be beneficial in teaching botany and in environmental conservation programmes. Previous research investigating perception of plants by school children has been promising, but also has been limited by the lack of a standard and psychometrically sound inventory of attitudes toward plants. We have constructed such an inventory—the Plant Attitude Scale (PAS). Given the importance of protecting biodiversity in general, and plants in particular, the PAS may be a useful tool for teachers as well as researchers.

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