

# Advances in research towards a theory of plant blindness

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## Prologue

The invitation to speak on September 12<sup>th</sup>, 2006 at the 6th International Congress on Education in Botanic Gardens, hosted by the University of Oxford Botanic Gardens, provided us with a new opportunity to share some research-based advances in our *theory of plant blindness* with a worldwide audience of botanic garden educators. We are indeed grateful for the chance to describe, albeit briefly, our progress in theory building, and to suggest some possible applications of the theory for informal science education at arboreta, nature parks, and botanic gardens.

Since 1989, the first author's visual cognition research laboratory (15° Laboratory) at Louisiana State University has been studying public and student understanding and awareness of plants. Key topics of investigation have included improving visual approaches to learning photosynthesis, the carbon cycle, rhizobotany, and what it means *to teach the whole plant*—a challenge set by the Botanical Society of America in its turn-of-the-century vision statement entitled: *Botany for the Next Millennium* (Niklas 1995).

## Toward a theory of plant blindness

After several years of interviews, library searches, and small-scale investigations, in 1998 our laboratory coined the term *plant blindness* and introduced it to the fields of biology education and botany education (Wandersee & Schussler 1999; 2001). We defined *plant blindness* as failing to see, take notice of, or focus attention upon the plants in one's everyday life. Subsequently, we have elaborated upon this definition, including the addition of supporting characteristics and symptomatic behaviors.

Simultaneously, we proposed a default human visual processing explanation for the public's lack of attention to and interest in plants, as exhibited in industrialized and post-industrialized nations such as the US, based on visual cognition research. Our primordial theory of plant blindness was set forth in Wandersee and Clary (2006) and Wandersee and Schussler (1999; 2001). The first and third sources cited here are also accessible online.

We undertook this intellectual project because we thought that the current state of inattention to and under-representation of plants—not just in biology instruction, but in informal science education settings, and in US society in general—might be better explained by using research-based principles of human perception and visual cognition than by earlier instructional-bias and deficiency-related hypotheses found in the botany education literature—such as zoocentrism, zoochauvinism, and plant neglect.

## Why a new term?

Why coin a new term? We wanted the term *plant blindness* to be free of what we considered to be accumulated and inappropriate connotations which the prior three terms possess, and to serve as a precursor term, signaling visual cognition explanations for some of the resultant learning-related problems. We cringe at the occasional contemporary misuse of all four terms in the literature, as though they were co-equal and synonymous. We see this as both dismissive and retrogressive. We argue that each term-- zoocentrism, zoochauvinism, plant neglect, and plant blindness--has a different embedded, underlying explanation. We share with Fisher (2001) the view that clarification of terms is a key step forward in advancing critical thinking.

In challenging the conventional wisdom, we have proposed that those first three behaviors (zoocentrism, zoochauvinism, plant neglect) are actually *symptoms* of the default *condition* of plant blindness (arising from how the human eye-brain system typically processes and attends to visual information), and thus are not foundational, causal explanations for the public's inattention to plants.

## Identifying plant blindness

We have found that persons afflicted with the condition known as plant blindness may exhibit symptoms such as the following: "(a) failing to see, take notice of, or focus attention on the plants in one's daily life; (b) thinking that plants are merely the backdrop for animal life; (c) misunderstanding what kinds of matter and energy plants require to stay alive; (d) overlooking the importance of plants to one's daily affairs (Balick & Cox 1996); (e) failing to distinguish between the differing time scales of plant and animal activity (Attenborough 1995); (f) lacking hands-on experiences in growing, observing, and identifying plants in one's own geographic region; (g) failing to explain the basic plant science underlying nearby plant communities—including plant growth, nutrition, reproduction, and relevant ecological considerations; (h) lacking awareness that plants are central to a key biogeochemical cycle—the carbon cycle; and (i) being insensitive to the aesthetic qualities of plants and their structures—especially with respect to their adaptations, coevolution, colors, dispersal, diversity, growth habits, scents, sizes, sounds, spacing, strength, symmetry, tactility, tastes, and textures" (Wandersee & Schussler 1999).

## Delimiting the theory of plant blindness

We also found the theory of plant blindness applies primarily to industrialized or post-industrialized societies, to urban and suburban settings, to those persons lacking a *Botanical Sense of Place* (Wandersee, Guzman, & Clary in press), and to those who have what Louv (2006) has called a *nature-deficit disorder*. The latter two factors are primarily personal and experiential, and highlight lives lived apart from plants.

How prevalent might plant blindness be? People are losing contact and experiences with agriculture and with nature. In the US of 200 years ago, 90% of the population farmed; now less than 2% of the population farms (National Council on Economic Education 2006). Half the world's population will live in cities by the end of 2006, up 30% from 1950; and this figure doesn't even include all the people living within what are called "very large urban areas" (UN Commission on Population 2005).

## Some research-derived visual principles that help to explain plant blindness

1. Norretranders (1998) has calculated that only .0000016 of the data our eyes produce are actually considered consciously. It seems that visual consciousness is like a spotlight, not a floodlight. By default, if plants are not an aid or a threat to survival, they are less likely to receive conscious attention via search imaging.
2. Plants can and do modify their visual signal values in accordance with the survival values conferred. Thus, they may appear more prominent at certain times of the year.
3. Mack and Rock (1998) have found that once objects have acquired meaning for an observer, they are more likely to be consciously perceived via vision. Inattention can become attention, once an object or event has acquired personal meaning.
4. Vision is anthropocentric—we pay more attention to human faces than anything else. Studies also show that people, being animals themselves, pay more attention to animals than to plants, even though, paradoxically, plants form the basis of most animal habitats and all life on earth (Abbott 1998).
5. To see an object in one's visual field, it is necessary to attend to it. Looking is not the same as seeing. We pay little attention to things that have little meaning for us. Solso (1994, p. 26) notes "...we gaze longer at interesting or puzzling things...."
6. The brain uses patterns of space, time, and color to structure visual experience (Zakia 1997). Because they are immobile autotrophs, plants in nature generally offer fewer spacing-based, time-based, or color-based visual cues for humans to observe than animals do—except, for example, during periods of pollination and dispersal (cf. Wandersee & Schussler 2000).
7. Gopnik, Meltzof, and Kuhl (1999, p. 65) claim that: "Paying attention to edges is the best way of dividing a static picture into separate objects." Plants often grow close together in populations, and thus have chromatic and spatial continuity. This makes it hard to see structural edges, and individual plants do not "pop out" from their background.
8. Humans can only focus on one thing at a time. Attention is a zero-sum game. Brightness, low color contrast, and lack of shadows under daytime lighting conditions make plants less conspicuous, minimizing optic flow, except near dawn and dusk
9. Human attentional capacity is idiosyncratic, and it also decreases with increases in drugs, alcohol, fatigue, and age.
10. Too many kinds of plants can seem overwhelming to consider—in one study, a maximum of 6 different visual choices was found to be ideal for viewer satisfaction, rather than arrays of 24 or 30, based on the research of Iyengar and Lepper (2000).

## Research-derived implications for preventing and remediating plant blindness

Some of our most robust and hopeful findings, based on three national studies and numerous site-based studies in the US and abroad, include:

1. The presence of a plant mentor earlier in a one's life (someone who helped the mentee observe, plant, grow, and tend living plants) is a key predictor of that person's awareness, appreciation, and understanding of plants throughout the lifespan.
2. As the practical value and degree of importance a person self-ascribes to the Plant Kingdom and its members increases, *plant blindness* decreases.
3. Lesser recognized but powerful interest generators that can help mitigate plant blindness include experiencing living plants, in context, that are food sources, or, that have ethnobotanical or contemporary medicinal applications.

4. Displays of what we have called *marquee plants* can increase garden and arboretum attendance. These plants represent selected specimens that have the ability to draw a crowd because they are the oldest, largest, smallest, widest, most massive, rarest, most odiferous, rarely blooming, and so forth. Unless highlighted in publicity and interpreted with gusto, visitors often walk by these without any sense of wonder. Every botanic garden has more potential marquee plants than it realizes. We have evidence that marquee plant experiences which increase one's perceived "sense of wonder" diminish plant blindness.
5. The plant-related experiences a mother will provide for her children can be predicted by her own plant-related experiences and by her own self-reported awareness of the presence of plants in her life.
6. As a person's experience and proficiency in using a carefully chosen taxonomic key and magnifying lens to compare, contrast, and identify plants increases, plant blindness decreases.
7. The more senses explicitly involved in a visit to an arboretum or botanic garden, the more memorable the visit, and the greater the impact of the visit toward alleviating plant blindness.
8. Providing garden visitors with paleobotanic (deep-time) interpretive perspectives and opportunities to see and touch actual plant fossil specimens related to the living plants that they are viewing (such as leaves and petrified wood) increases total viewing time, as well as attention to, and appreciation of plant evolution and plant diversity in living garden collections. Plants have a past! Plants are members of families! These temporal and phylogenetic dimensions are seldom explained or interpreted (Clary & Wandersee in final review). History...illuminates reality, vitalizes memory, ...and brings us tidings of antiquity.—Marcus Cicero, ca. 44 BCE.

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## Biographies

James H. Wandersee, botanist, and Renee M. Clary, geologist, are co-founders of the EarthScholars™ Research Group. They do university- and field-based visual cognition and archival research aimed at improving and integrating biological and geological learning. A principal goal is to improve public understanding of these two sciences on natural trails and at informal science education sites, specifically—arboreta, botanic gardens, fossil parks, nature parks, and public caves.