Visual Impairment and Olfactory Acuity

Continuing the exploration of the relationship between visual impairment and smelling ability.

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The blind and visually impaired typically experience the well-described phenomena of an increase in acuity and perception of the remaining senses.[1–4] Olfactory acuity is the least studied of the remaining senses, and yet an increased ability in this area is a prized asset in the fragrance industry, which could provide employment for individuals with such skills.

The relationship between visual impairment and smelling ability has been explored in a previous study conducted in India. Results of this study showed that the blind and visually impaired group were more than twice as likely to pass the industry standard smelling test as the normally-sighted control group.[5] Following the publication of these results, the fragrance industry in the region has been encouraged to support employment of the blind and visually impaired, with five graduates of V.G. Vaze College Mumbai's Certificate Course in Perfumery and Evaluation for the Visually Impaired now employed in the industry.[a,b]

This study aimed to repeat the Indian study in a U.K. population, to provide further data to support the idea of increased olfactory ability in the blind and visually impaired, and also to support the long-term goal of encouraging the fragrance industry to employ such individuals. This study was conducted by CPL Aromas, a multinational fragrance manufacturer with headquarters in the United Kingdom, with assistance from the Royal National Institute of Blind People (RNIB), Hertfordshire Society for the Blind (HSB) and Kettering Sight Centre.

Methods

Participants: Inclusion and exclusion criteria for entry onto the study are detailed in **T-1**. Thirty blind or visually-impaired participants were recruited to the case group via a request for volunteers from the RNIB, HSB and Kettering Sight Centre. Age distribution of the case group was 18–64 years (mean: 39.4, SD 13.4). Seventeen of these were male and 13 were female. Thirty-one normally-sighted participants were recruited to the control group and matched for age and gender. Age distribution of the control group was 18–70 years (mean 35.7, SD 14.0). Fourteen of these were male and 17 were female (**T-2**).

Smelling test: The test used to measure olfactory ability was the industry standard "smelling test," replicating the methods used in the Indian study.[5] The test comprises two elements, the triangle test and the strength test.

Triangle test: The participant is presented with three scents and asked to identify whether: a) they are identical; b) one is an "odd-one-out" (and, if so, to identify which one); or c) all three are different scents. The test comprises eight such triangles, with one point available for each correct triangle.

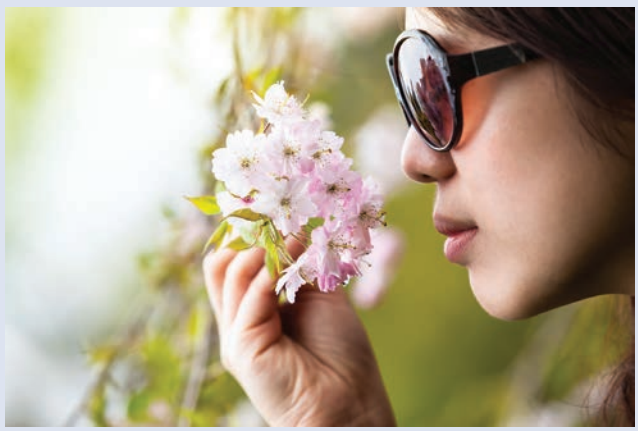
Strength test: The participant is presented with five different dilutions of the same scent, and is asked to rank the five samples in order of strength. Five points are available for the correct ordering of the samples.

[a]*www.vazecollege.net/index.html*
[b]CPL Press Release: "Fragrance Houses recruit visually impaired students in key positions," April, 2014

At a Glance & Further Reading

This case-control study, conducted in the United Kingdom, builds on previous research conducted in India and provides further evidence that the sense of smell is effectively more acute in the blind and visually impaired. The smelling ability of a group of blind and visually impaired individuals was tested using a fragrance industry standard "smelling test." A group of normally-sighted individuals matched for age and gender were used as controls. The results showed that the blind and visually impaired have greater practical smelling ability than the normally-sighted, a skill which is highly valued within the fragrance industry.

Read more about a previous related study in "Visual Impairment and Olfactory Acuity" on Page 22–24 of the February 2012 edition of *Perfumer & Flavorist* Magazine; *www.perfumerflavorist.com/magazine/pastissues/.*



T-1. Inclusion and exclusion criteria for the case (blind and visually impaired) and control (normally-sighted) groups

	Inclusion criteria	Exclusion criteria
Both groups	≥ 18 years of age	< 18 years of age
		Any mental health issues that may result in vulnerability or lack of understanding of the study or how to complete the test
		Anosmia (lack or severe impairment of sense of smell)
Case group	Registered blind or partially sighted	
Control group		Any visual impairment beyond the wearing of spectacles or contact lenses

T-2. Age and gender characteristics for the case (blind and visually impaired) and control (normally-sighted) groups

	Case group (visually impaired)	Control group (normally sighted)
Total	30	31
Total	17 (56.7%)	14 (45.2%)
Female	13 (43.3%)	17 (54.8%)
Mean age	39.4 (SD 13.4)	35.7 (SD 14.0)

T-3. Summary of smelling test results (pass/fail) for the case (blind and visually impaired) and control (normally-sighted) groups

	Case group (visually impaired)	Control group (normally sighted)
Total	30	31
Pass	18 (60.0%)	9 (29.0%)
Fail	12 (40.0%)	22 (71.0%)

T-4: 2x2 contingency table showing results of the smelling tests for the case (blind and visually impaired) and control (normally-sighted) groups

	Outcome occurred (smelling test pass)	Outcome did not occur (smelling test fail)	Totals
Risk factor present (case group)	18	12	30
Risk factor absent (control group)	9	22	31
Totals	27	34	61

T-5. Summary of statistics calculated from the 2x2 contingency table

Test			p-value
Chi-square (Pearson uncorrected)=5.926			0.015
Two-tailed Fisher's exact test			0.021
		95% Confidence Interval	
Odds ratio (OR)	3.667	1.119	12.353
Relative risk (RR)	2.067	1.064	4.166

T-6. Comparison of results from previous study (Indian population) and current study (U.K. population)

	Indian study		U.K. study	
	Case	Control	Case	Control
%Male	72.8	96.8	56.7	45.2
%Female	27.2	3.2	43.3	54.8
Mean age	30	31	39	36
%Pass	23.7	11.3	60.0	29.0
%Fail	76.3	88.7	40.0	71.0
Significance (Fisher's exact)	p=0.039		p=0.021	
Chi-square	4.610 (p=0.032)		5.926 (p=0.015)	
Odds ratio	2.44		3.67	

Marking: A total of 13 points are available from the completed smelling test (eight from the triangles, five from the strength test). A score of nine points or greater is considered to be a pass. The expected pass rate within the fragrance industry for non-trained personnel is typically 10%.[6] The pass rates from the Indian study were shown to be 11.3% for the control group and 23.7% for the blind and visually impaired group.[5]

The tests were administered by the author, who had received the appropriate training from staff at CPL Aromas. The author remained unaware of the correct test responses throughout the data collection period. Responses were assessed by CPL Aromas' perfumery staff after being anonymized through a coding system so that the assessors would be unaware of group allocation. The study was therefore designed to be double-blinded.

Results

Smelling test results: From the blind and visually impaired group of 30 participants, 18 individuals achieved a score of nine or greater, giving a pass rate of 60.0%. From the control group of 31 participants, nine individuals achieved a score of nine or greater, giving a pass rate of 29.0% (summarized in **T-3**).

Statistical analysis: As the outcome measured is binary (pass/fail), a 2x2 contingency table can be used for statistical analysis. The online statistical calculator StatPages was used to calculate the results from the 2x2 table (**T-4**) and obtain the odds ratio (OR) and chi-square statistic.[c]

The blind and visually impaired group achieved a pass rate of 60.0%, compared to a pass rate of 29.0% in the control group. The difference in outcome between the two groups was statistically significant (chi-square [Pearson] of 5.926 [p=0.015]; two-tailed Fisher's exact test, p=0.021) (**T-5**). The odds ratio of 3.67 (95% CI 1.12–12.35) indicates that the odds of achieving the outcome are over three and a half times higher for the blind and visually-impaired group (T-5); thus, a blind or visually impaired individual is more than three and a half

[c] *http://statpages.org/ctab2x2.html*

times more likely to pass the smelling test than a normally-sighted individual.

Discussion

In this controlled study conducted in the United Kingdom, individuals with a visual impairment were shown to have greater olfactory acuity than the normally-sighted. Visual impairment was shown to be associated with a significantly increased likelihood (OR=3.67) of passing the smelling test used in the fragrance industry.

These results provide further support to the findings of the Indian study, showing that the correlation between visual impairment and olfactory acuity has been reliably demonstrated in two separate global regions.[5] **T-6** shows a comparison of the results from both studies.

Furthermore, it is hoped that the dissemination of these results will inspire the visually impaired to seek employment in the fragrance industry, and at the same time encourage the industry to take steps to facilitate this. The previous study has led to positive results within the visually impaired community in India, and similar results could be seen in other regions.[5]

Limitations/future studies: Participants were recruited into this study from the U.K. population, and thus the results are only generalizable to that population. This study has used the same methodology as the previous study conducted in India, and so the results are directly comparable.[5] The methodology should be used to repeat the study in other global regions. Further analysis could be conducted on the collated results from multiple future regional studies.

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Competing Interests

The author is employed by CPL Aromas Ltd., a global fragrance manufacturer with headquarters based in the United Kingdom. All expenses incurred in the undertaking of this study were funded by CPL Aromas Ltd.

Author's Contributions

Garry Dix planned and coordinated the study, administered the smelling tests, wrote the manuscript, performed statistical analysis and prepared all summary tables therein.

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