WAGENINGEN UR
For quality of life

Relaties tussen planteigenschappen en welbevinden van mensen

Literatuuronderzoek

Ir. M.H.A. Hoffman



Rapport 146

PLANT RESEARCH INTERNATIONAL
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Wageningen UR, Wageningen
juni 2007

Rapport 146

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Inhoudsopgave

1. Inleiding

Over de relatie tussen groen en tuinen en de invloed daarvan op het welbevinden van mensen is al veel bekend en geschreven. Hierover is oa. binnen WUR al het nodige onderzoek gedaan, bijvoorbeeld door PRI en Alterra). Aangetoond is dat een groene omgeving (natuur, stedelijk groen, tuinen, kamerplanten, etc.) positief werken op het welbevinden van mensen. Minder bekend is welke specifieke relaties hieraan ten grondslag liggen; welke kleuren, geuren, vormen, geluiden, specifieke plantensoorten, etc.?
Dit rapport is het resultaat van een zoektocht in verschillende literatuurdatabases en Internet naar specifieke relaties tussen planteigenschappen en welbevinden van mensen. Hierbij is gezocht naar wetenschappelijke publicaties in het groene, medische en cosmetische circuit.

Deze literatuurstudie is uitgevoerd in opdracht van Zorglandgoed de Hoge Born. Op de Hoge Born wordt een healing garden ontwikkeld. De verzamelde kennis wordt gebruikt bij de invulling van de healing garden.

De studie is mogelijk gemaakt door financiering uit thema duurzame landbouw van de kennisbasis.

2. Materiaal & methoden

2.1 Gebruikte literatuurdatabases en zoekmachines

Algemeen

- Zoekmachine Google-scholar: http://scholar.google.nl
- Verzamel literatuurdatabase Webspirs: www.webspirs.nl
- Literatuurdatabase Scopus: www.scopus.com
- Web of knowledge: http://portal.isiknowledge.com

Botanisch/biologisch

- CAB-Abstracts
- Biological-Abstracts

Menswetenschappen

- Medische literatuurdatabase Ispub: http://www.ispub.com
- Medische literatuurdatabase medline: http://medline.cos.com
- Biomed Central: www.biomedcentral.com
- PsycINFO

Cosmetische industrie

- Cosmetische literatuurdatabase Kosmet: www.kosmet.com (niet gratis)
- www.scentralaire.com/Articles&Abstracts.htm

2.2 Gebruikte zoektermen

De volgende combinaties van zoektermen zijn gebruikt

Nederlandse termen

- Gemoedstoestand/welbevinden/stemming/psyche
- Geur
- Kleur
- Geluid
- Planten/plantensoort

Engelse termen

- Mood/temper/psyche/well-being
- Scent/fragrance/odor/odour
- Colour/color
- Sound
- Plants/plantspecies

2.3 Verwerking literatuurbronnen

Relevante literatuurbronnen (inclusief abstracts) zijn opgenomen in de literatuurdatabase Endnote. Aan de hand van de abstracts is de meest relevante en concrete informatie in Hoofdstuk 3 per onderdeel (geur, kleur en geluid) gerangschikt.

In bijlage 1 zijn de gebruikte literatuurbronnen en de bijbehorende abstracts weergegeven.

3. Resultaten

3.1 Algemene opmerkingen

- Veel publicaties (ca. duizend) over geuren, kleuren en geluid in relatie tot gedrag en marketing (in bladen als JOURNAL OF ENVIRONMENTAL PSYCHOLOGY, JOURNAL OF BUSINESS RESEARCH, PSYCHOLOGY & MARKETING, JOURNAL OF APPLIED SOCIAL PSYCHOLOGY, JOURNAL OF RETAILING, CHEMICAL SENSES, JOURNAL OF RETAILING, PSYCHOLOGICAL BULLETIN, ADVANCES IN CONSUMER RESEARCH, JOURNAL OF THE ACADEMY OF MARKETING SCIENCE. Wellicht zitten hier interessante zaken tussen, maar heeft in deze fase geen prioriteit.
- In Gender-studies is vrij veel onderzoek gedaan naar geur in relatie tot bijvoorbeeld geslacht, menstruatiecyclus, etc. Wellicht zitten hier interessante zaken tussen, maar heeft in deze fase geen prioriteit.
- Er zijn ook vrij veel publicaties over negatieve aspecten van geur en geluid, bijvoorbeeld van verkeer of veehouderij. Deze zijn niet geselecteerd.
- Vooral in psychologie is ook veel onderzoek gedaan naar verwerking van geur- & kleurprikkels in de hersenen. Dit heeft in dit onderzoek vooralsnog geen prioriteit.
- In de cosmetische branche is ook veel onderzoek gedaan naar de invloed van geur op welbevinden van mensen. Er is een literatuurdatabase beschikbaar op internet: Kosmet: http://www.kosmet.com. Deze is niet gratis: € 4,- per artikel/abstract of € 210,- per jaar. Een deel van deze artikelen staat ook in www.scentralaire.com/Articles&Abstracts.htm. Hieruit zijn enkele relevante artikelen opgenomen.
- Er veel informatie over kleurtherapieën en aromatherapieën. Deze therapieën bevinden zich op het grensvlak van alternatieve geneeskunde. In dit onderzoek zijn alleen de wetenschappelijke artikelen opgenomen.

3.2 Specifieke bronnen

Er is niet één bron of tijdschrift die er qua relevantie van de gegevens met kopen schouders bovenuit springt. Relatief veel artikelen/informatie staat in de volgende tijdschriften:

- Chemical Senses (vooral over geur)
- Color Research and Application (over kleur)
- International Journal of Neuroscience
- International Journal of Aromatherapy (vooral over geur)
- Perceptual and Motor Skills (vooral over kleur)
- Psychological Reports

Er is ook een aantal relevante boeken geschreven. De boeken zijn beoordeeld op grond van referenties en samenvattingen. Aan de hand hiervan kon weinig concrete informatie worden ontleend. De volgende boeken zijn geheel of gedeeltelijk (middels kopieën) aangeschaft:

- Classen *et al.* (1994): Aroma: The cultural history of smell
- Herz (2002): Influence of odor on mood and affective cognition (Hoofdstuk uit het boek: Rouby *et al.* (2002): Olfaction, taste and cognition)

De volgende boeken zijn niet aangeschaft maar bevatten wellicht nog wel interessante informatie:

- Dodd *et al.* (1992): From moods to molecules: The psychopharmacology of perfumery and aromatherapy
- Ehrlichman *et al.* (1992): The use of odour in the study of emotion
- Rouby *et al.* (2002): Olfaction, taste and cognition
- Tisserand (1988): Essential oils as psychotherapeutic agents

3.3 Informatie per onderwerp

3.3.1 Invloed van (planten)geur

Concrete planten of geurstoffen

- Lavendel- en Rozemarijngeur kunnen vermoeidheid verminderen; lagere scores op ' fatigue-inertia subscale' / POM (Burnett *et al*, 2004; Diego *et al.* (1998)).
- Rozemarijngeur verhoogt alertheid en/of cognitieve prestatie (Burnett *et al.,*2004; Diego *et al.* (1998); Moss *et al*. (2003))
- Lavendelgeur vermindert cognitieve prestatie en alertheid (Moss *et al.*,2003).
- Lavendelgeur verbetert de stemming / heeft ontspannende werking bij mensen (Field *et al.,*2005). Soortgelijke bevinding door Knasko (1992) Motomura *et al.* (2001), Yotsuya *et al.* (1999) en Moss *et al.* (2003).
- De onspannende werking van lavendelgeur is chemisch niet te verklaren; gesuggereerd wordt dat de geur bij veel (westerse) mensen associeert met ontspanning vanwege gebruik in b.v zeep, geurkaarsen en badolie (Herz, 2002)
- Gebruik van lavendelolie als aromatherapie vermindert angstigheid bij hemodialysepatiënten (Itai *et al.,*2005).
- Lavendelgeur vermindert slapeloosheidklachten en depressie bij vrouwen (Lee *et al.,*2006)
- De (planten)geurstof linalol (o.a. in Lavendel en Tijm) zorgt oa. voor verlaging bloeddruk, maar invloed op welbevinden (subjectieve beoordeling) werd niet aangetoond (Heuberger *et al.*, 2004).
- Geur van Marjolein (*Origanum majorana*) heeft ontspannend (antistress) effect (Han *et al.*, 2004).
- De geur van jasmijnthee en R-linalol (= belangrijke inhoudsstof van Jasmijn) hebben kalmerende werking en positieve invloed op stemming (Kuroda, 2005).
- Ylang-ylang olie (*Cananga odorata*) veroorzaakt significante daling van bloeddruk en polsslag en significante toename van subjectief gemeten alertheid en concentratie (Hongratanaworakit *et al.* (2004)
- Inhalering van etherische olie van Zoete sinaasappel (*Citrus sinensis*) geeft significante toename van hartslag en subjectief gemeten alertheid (stimulerend effect). Dit geeft potentie voor inzet bij milde vorm van depressie en stress bij mensen (Hongratanaworakit *et al.* (2005)
- Citrus-geur vermindert depressieve klachten; de dosering van antidepressiva kan daardoor behoorlijk omlaag (Komori *et al.,*1995)
- Citroengeur verzacht vermoeidheidssymptomen en werkt krachtsstimulerend in werksituatie (Kawamoto, 2005). Soortgelijke bevinding door Knasko (1992).
- De (planten)geurstof limoneen (citroengeur) heeft zorgt bij inhalering voor: bloeddrukverhoging (systolgisch), verhoging subjectieve alertheid en verhoging rusteloosheid. De geurstof ' carvone' heeft soortgelijke effecten (Heuberger *et al.,*2001).
- Etherische olie van Sandelhout verhoogt de polsslag, geleidingsniveau van de huid en systolische bloeddruk. Alpha-Santanol (belangrijk bestanddeel van Sandelhout) heeft een sterkere werking (alertheid en stemming) dan de etherische olie als geheel.
- Gebruik van Hiba-olie (*Thujopsis dolobrata*) als aromatherapie vermindert depressie en angstigheid bij hemodialysepatiënten (Itai *et al.,*2005).
- Aromatherapie met een mengsel van Lavendel-, Marjolein-, Eucalyptus-, Rozemarijn- en Muntolie vermindert de pijn bij reumapatiënten (Kim *et al.,*2005 (1)).
- Aromatherapie in combinatie met massage met een mengsel van Rozemarijn-, Citrus- en Muntolie werkt positief bij constipatie bij oudere mensen (Kim *et al.,*2005 (2)).
- Methylsalicilaat, met name te vinden in *Gaultheria procumbens* (' Wintergreen') wordt in de VS als veel aangenamer ervaren dan in Engeland. Dit heeft waarschijnlijk als oorzaak dat deze stof in Engeland veel gebruikt wordt in de medische wereld en in de VS veel in snoepjes wordt gebruikt.
- Er is een relatie tussen geurbeleving en werkzaamheid. Cyperusgeur wordt bijvoorbeeld vooral na fysiek werk als positief ervaren; geur van Juniperus vooral na mentaal werk (Sugawara *et al.* (1999).

Algemene invloeden van geuren

- Verwachtingen t.a.v. werking spelen significante rol in stemming opgeroepen door geuren (bv. Lavendel en Neroli geuren; Campenni *et al.* (2004)). Iets soortgelijks wordt gevonden door Dalton (1996), Higuchi *et al.* (2002) en Broughan (2005).
- Het belang van verwachtingen t.a.v. de werking is ook aangetoond bij het inzetten van aromatherapie bij pijnbestrijding (Gedney *et al.* (2004))
- Geuren kunnen cognitieve prestaties beïnvloeden (Moss *et al.*, 2003)
- Geur kan emotionele staat van mensen beïnvloeden, bijvoorbeeld negatieve gevoelens temperen en welbevinden vergroten (Burnett *et al.,*2004; Heuberger *et al.,*2001; Moss *et al.*, 2003; Retiveau *et al.*, 2004; Schiffman *et al.,*1994).
- Aromatherapie kan stress verminderen (Shimizu, 2000)
- Aangename geuren verhogen het welbevinden van mensen en onaangename geuren verlagen het welbevinden van mensen (Herz, 2002)
- Geuren hebben indirect invloed op taakuitvoer en stemming; ze gaan door een ' emotiefilter' , welke beïnvloed wordt door o.a persoonlijke ervaringen. Hiermee is geurbeleving gedeeltelijk persoonafhankelijk (Hatayama, 1999).
- Aangename geuren zorgen ervoor dat taken beter uitgevoerd worden (diverse studies, zie Herz, 2002)
- Geuren worden in belangrijke mate geassocieerd met eerder opgedane positieve of negatieve ervaringen (Herz *et al.,*2004). Diverse andere bronnen bevestigen dit, o.a. Herz (2002), Heuberger *et al.,*(2001) en Knasko (1995).
- Geuren kunnen door beïnvloeding van de stemming ook pijnperceptie beïnvloeden (Villemure *et al.* (2003). Bij vrouwen is er een relatie tussen geurprikkel en pijnperceptie; bij mannen niet (Marchand *et al.* (2002).
- De aard van een psychiatrische aandoening is van invloed op geurbeleving (Lombion, 2006).
- De invloed van geur op de stemming/emotionele toestand van mensen wordt versterkt door de juiste omgeving en de bereidwilligheid van de persoon om de werking te ondergaan (Jellinek, 1997).
- Personen die worden blootgesteld aan aantrekkelijke dan wel onaantrekkelijke geuren hebben geen meetbare verschillen in taakuitvoering, stemming en gezondheid. Wel denken de personen die aan onaantrekkelijke geuren zijn blootgesteld minder hoog te scoren op deze drie aspecten (Knasko, 1993 en vergelijkbaar Knasko, 1990).
- Het reactievermogen van personen neemt af in een omgeving met veel geurprikkels (onafhankelijk van de aard van de prikkel). Dit bevestigt het belang van geur en omgeving in relatie tot menselijk gedrag Millot *et al.* (2002).
- Er zijn pogingen gedaan om geuren te visualiseren door kleuren; dit blijkt gedeeltelijk succesvol en gedeeltelijk lijken emotionele associatie vertroebelend te werken (Schifferstein *et al.* (2004)
- Schiffman (1992) gaat in op het fenomeen verminderen van geurwaarneming bij ouderen. Een versterking van geur(vermogen) kan verschillende voordelen opleveren en het welbevinden van ouderen verhogen.
- Reactie op geur door mensen is grotendeels gebaseerd op aangeleerd gedrag, met uitzondering van irriterende geurstoffen zoals ammonia (Herz, 2002).
- Warrenburg (2002) heeft een systeem ontwikkeld waarin geuren worden geassocieerd met stemmingen (8 categorieën): zg. ' Moodmapping' systeem. Tevens is een database ontwikkeld waarin allerlei geuren (van parfums, bloemen, vruchten, specerijen, etc.) worden ingedeeld. Deze database is gekoppeld aan de zg. ' Consumer Fragrance Thesaurus' , een veel gebruikte tool in de parfumindustrie. Dit vormt een basis voor het ontwikkelen van Aromatherapieën en nieuwe parfums.
- Herinneringen die worden opgewekt a.d.h.v geuren zijn duidelijk meer emotioneel dan herinneringen die worden opgewekt a.d.h.v. andere belevingen (Herz, 2002)

3.3.2 Invloed van (planten)kleur

- Kleur van muur in kantoor geen effect op stemming en prestatie (Ainsworth *et al.* (1993)
- Voldoende licht goed kleurgebruik (binnenshuis) leveren een positieve bijdrage aan het welbevinden van mensen (Kuroda *et al.,*2005)

- Het effect van kleuren in een therapeutische ruimte op de emotionele stemming bij mensen is aangetoond door Coryell (2003). Er zijn twee categorieën: warme kleuren (rood, oranje, geel) en koude kleuren (blauw, groen). Uit de samenvatting blijkt nog niet wat het effect precies is, maar lijkt zeer relevant artikel.
- Lichte heldere kleuren wekken positieve emoties op bij kinderen en donkere kleuren (bruin, zwart grijs) negatieve. (Boyatzis *et al.* (1994). Iets soortgelijks wordt door Hempill (1996) ook bij volwassen gevonden. Daarbij is het effect bij vrouwen groter dan bij mannen.
- Een roze kamer (omgeving) stimuleert creatieve stemming en fysieke kracht; blauw doet het omgekeerde (Hamid *et al.,*1989)
- In een experiment met verschillende groepen mensen/patiënten wordt door ' normale mensen' , patiënten met neurotische aandoening en borderline patiënten worden rode kleuren geassocieerd met angst en liefde (Leichsenring, 2004).
- Blauw-violet wordt geassocieerd met verdriet en vermoeidheid; koel-groene kleuren met boosheid en verwarring (Levy, 1980).
- In een onderzoek naar kleurvoorkeuren door Valdez *et al.* (1994): Blauw, blauwgroen, groen, roodpaars, paars en paarsblauw worden hoog gewaardeerd. Geel, groengeel worden het minst hoog gewaardeerd. Groengeel, blauwgroen en groen zijn het meest prikkelend; paarsblauw en geelrood bleken het minst prikkelend.
- Kleuremotie en -voorkeur persoonlijk bepaald (Schaie (1961).
- Kleurvoorkeur is sterk gekoppeld aan kleurhamonie, maar gaat soms niet op (Ou *et al.,*2004).
- Het is moeilijk om kleurcombinatievoorkeuren te voorspellen a.d.h.v kleuremotie (Ou *et al.,*2004).
- Kleurtint, kleurintensiteit en helderheid in relatie tot emotie zijn afzonderlijk gemeten. Hieruit komt naar voren dat het effect van kleurtint minder significant is dan uit voorgaande studies bleek. Kleur intensiteit en helderheid hebben een belangrijkere invloed (Gao *et al.* (2006)
- Naar Chinese maatstaven is er een ' Kleurenplanner in relatie tot emoties' gemaakt voor ontwerpers op allerlei gebieden. Hiermee a.d.h.v. kleurkeuzes voor producten bepaalde gevoelens worden opgeroepen. De relatie kleur-emotie is wel cultuur- en traditie bepaald. (Cheng et. al. (2001)
- Vervolg onderzoek (Chinees) toont aan dat sommige kleuremoties niet cultureel bepaald zijn (Ou *et al.*, 2004)
- Ou *et al.* (2006) heeft onderzoek gedaan naar 2-kleurenharmonie: welke kleurenparen harmoniëren en welke niet. In de samenvatting staan geen concrete resultaten.
- Ververkova (2002; 2x) geeft een historisch overzicht en stand van zaken in kleurpsychologie.

3.3.3 Invloed van geluid

In deze fase is hier nog niet op gefocust. Bij planten en tuinen is geluid ook meer indirect van belang. Ruisen van blad is direct en concreet. Het ontbreken van geluid (stilte) kan ook effect hebben op welbevinden van mensen. Hierover zijn diverse wetenschappelijke publicaties geschreven. Dit geldt ook voor de invloeden van muziek en de invloeden van storende geluiden (bv. industrie en verkeer).

3.3.4 Algemeen

- Tuinbezoek verhoogd welbevinden van mensen (indicatief): Rappe *et al.* (2005).
- Een kamerplant in het kantoor verhoogt het welbevinden en de prestatie. In h*et al*gemeen wordt aangetoond dat de (werk)omgeving van invloed is op kwaliteit van taakuitvoer en welbevinden van mensen (Shibata *et al.* (2004)

Verder geen artikelen geselecteerd over effect van groen en/of tuinieren en/of natuur, maar er zijn er vele.

3.4 Diverse relevante informatie

Praktijktoets naar gunstige invloed van planten op werkvloer (Lopend onderzoek)

Dat de aanwezigheid van planten op de werkvloer een gunstige werking heeft op de gezondheid, het welzijn en de productiviteit van werknemers is algemeen bekend. De vraag is nu hoe deze positieve effecten beter benut kunnen worden bij de bedrijven in Nederland. De Sectorcommissie bloemkwekerij trok in de vergadering van 13 september 2006 totaal 146.000 euro uit voor een praktijktest.
TNO gaat het onderzoek uitvoeren. Onderzocht wordt welke planten en kenmerken van planten de meeste positieve eigenschappen opleveren voor werknemers. In een experiment in het laboratorium worden deze uitkomsten nader geanalyseerd en vervolgens weer uitgetest bij drie organisaties in de sector zorgverzekeraars. Bloemenbureau Holland zal de uitkomsten communiceren naar de doelgroepen.

Praktische literatuur

In praktijk wordt bij tuinontwerp al veel gewerkt met kleur en geur. Hierbij zijn diverse populaire en semi-wetenschappelijke artikelen en tuinboeken beschikbaar. Zeer specifiek voor kleur en geur zijn:

- GENDERS, R. (1994): Scented Flora of the World - Robert Hale, London
- HOFFMAN, M.H.A. (2005): Geurende houtige gewassen en vasteplanten: Dendroflora 42, p. 26-88
- BONAR, A. (1990): Gardening for fragrance - Ward Lock Ltd.
- LACEY, S. (1991): Scent in your garden - Frances Lincoln Limited, London
- BOS, T. (2002): Kleur Groen – Ebben Boomkwekers, 224 p. (incl. literatuurlijst met diverse boeken over kleur)

4. Discussie

Plantengeur

Van alle menselijke zintuigen in relatie tot planten is van geur veruit het meest bekend en gepubliceerd. Er is vooral veel bekend over geurbeleving in h*et al*gemeen. Over de specifieke werking van bepaalde geurende plantensoorten zijn ook enkele tientallen artikelen gepubliceerd. Vaak worden hierbij dezelfde plantensoorten onderzocht, zoals Lavendel en Citrus-achtigen. Uiteindelijk zijn slechts van een tiental verschillende plantensoorten min of meer specifieke werkingen vermeld in de literatuur. Daarbij gaat h*et al*leen maar over de zeer bekende geurende planten waarvan etherische oliën ook in industrie veel worden gebruikt. Ten opzichte van honderden geurende plantensoorten in de Nederlandse tuinen en tienduizenden geurende plantensoorten wereldwijd, is de kennis echter uiterst beperkt.

Werkzaamheid van geurende planten of geurstoffen is genoemd bij de volgende klachten:
- Depressie (Lavendel, Citroen, *Thujopsis dolobrata*)
- Stress (Lavendel, Marjolein, Jasmijn, Zoete sinaasappel)
- Vermoeidheid (Lavendel, Rozemarijn, Citroen)
- Pijn (m.n. bij vrouwen; mengsel van diverse geurstoffen)
- Slapeloosheid (Lavendel)
- Angstigheid (Lavendel, *Thujopsis dolobrata*)
- Concentratiestoornissen (Rozemarijn, Ylang ylang, Citroen, Sandelhout)

Opvallend is dat in veel gevallen de werking is aangetoond, maar dat er geen chemische/fysieke verklaring voor is. Opvallend is verder dat vooral Lavendel bij heel verschillende klachten wordt ingezet. In diverse onderzoeken is aangetoond dat verwachtingen ten aanzien van de werking een grote rol spelen. De bereidheid van personen om de werking te ondergaan is van groot belang. Bovendien is geurbeleving sterk cultuurgebonden en ook deels persoonsafhankelijk, met name door belevingen en associaties uit het verleden. Bij veel mensen wekken diverse planten en bloemgeuren positieve emoties op. Hiervan kan in evt. therapeutische behandeling en in healing gardens dankbaar gebruik gemaakt worden. Het lijkt aan te raden in een healing garden verschillende geuren toe te passen, omdat de beleving van geuren deels persoonsafhankelijk is.

Plantenkleur en invloed van geluid

Over de invloed van kleuren op het welbevinden van mensen is wel het één en ander bekend. Er is vooral veel onderzoek gedaan naar kleurgebruik (m.n. muren) binnenshuis. In grote lijnen wekken donkere kleuren negatieve emoties op en lichte kleuren positieve emoties. Dit is echter ook weer sterk cultureel en persoonlijk bepaald. In relatie tot planten zou je je wel iets kunnen bedenken bij therapeutische werking van kleur; bijvoorbeeld door gebruik van specifieke kleuren (bv. alleen wit bloeiende soorten of pastelkleuren) of kleurmengsels (bonte tuin) bij de keuze van planten en tuinmateriaal. Dit heeft echter zijn beperking vanwege de dynamiek van groei en bloei (o.a. bloeitijden) in een tuin. Hierbij kan ook gebruik gemaakt worden van de positieve associatie die veel mensen hebben met groen.

Wat betreft het geluid is vooral het ontbreken van (storend) geluid (stilte) van belang in relatie tot welbevinden. Indien planten/tuinen worden ingezet in therapeutische behandeling is het van belang optimaal gebruik te maken van de rust en stilte die planten en tuinen kunnen bieden. Storend geluid van snelwegen, vliegtuigen, industrie, etc. zou vermeden moeten worden. Ook evt. ruisend blad (en de vaak bijbehorende associatie met rust) van diverse bomen en grassen en het geluid van water zou een rol kunnen spelen.

Bijlage I.
Literatuurbronnen (incl. abstract)

Ainsworth, R.A., L. Simpson, *et al.* (1993).

' Effects of three colors in an office interior on mood and performance.' Perceptual and Motor Skills. 1993; 76(1): 235-241.

This study examined the effects of three hues on subjects' performance and mood while in an office work environment for 1 hour. Pretest/posttest measurements were completed. Work performance was measured using words typed, typing errors, and a ratio of errors to words typed. Anxiety, depression, and arousal were measured by the Eight State Questionnaire of Curran and Cattell. A total of 45 women, ages 18 to 24 years, were tested individually in a single office space: 15 when the office walls were painted red/warm, 15 when walls were blue-green/cool, and 15 when walls were white/neutral. Analysis of covariance of posttest measurements with the pretest as a covariate showed no significant differences among the three groups on performance or scores on anxiety, depression, and arousal. If color of the environment has an effect on work performance or mood, either the effect was too small to be detected with samples of 15 subjects or longer participation than one hour was required.

Bensafi, M.,C. Rouby, *et al.* (2002).

' Influence of affective and cognitive judgments on autonomic parameters during inhalation of pleasant and unpleasant odors in humans.' Neuroscience Letters 319(3): 162-166.

Hedonic tone is so salient in odor perception that several authors have used odors to induce affective states. Various studies have shown that the electrophysiological and psychophysiological response patterns induced by olfactory stimuli are different for pleasant and unpleasant odors, and that these types of odor activate brain structures differentially. These results suggest that odors are first categorized according to pleasantness. The objective of the present work was to study the possible existence of an involuntary affective categorization in olfaction. Given that certain variations in the autonomic system, such as skin conductance amplitude and heart rate, are not under the voluntary control of human subjects, we used such psychophysiological methods for this investigation. Our results indicate that unpleasant odors provoke heart-rate acceleration during both a smelling task (control condition: a task in which subjects had only to inhale odors) and a pleasantness judgment, but not during a familiarity judgment. These results suggest that subjects involuntarily categorize odors by their pleasantness. (C) 2002 Published by Elsevier Science Ireland Ltd.

Boyatzis, C.J. and R. Varghese (1994).

' Children's emotional associations with colors.' The Journal of genetic psychology ; child behavior, animal behavior, and comparative psychology 155(1): 77-85.

In this study children's emotional associations with colors were investigated. Sixty children (30 girls, 30 boys), equally divided into groups of 5-year-olds and 6 1/2-year-olds, were asked their favorite color and were then shown nine different colors, one at a time and in a random order. For each color, children were asked, ' How does (the color) make you feel?' All children were able to verbally express an emotional response to each color, and 69% of children's emotional responses were positive (e.g., happiness, excitement). Responses also demonstrated distinct color-emotion associations. Children had positive reactions to bright colors (e.g., pink, blue, red) and negative emotions for dark colors (e.g., brown, black, gray). Children's emotional reactions to bright colors became increasingly positive with age, and girls in particular showed a preference for brighter colors and a dislike for darker colors. Boys were more likely than girls were to have positive emotional associations with dark colors. Potential sources for children's color-emotion concepts, such as gender-related and idiosyncratic experiences, are discussed.

Broughan, C. (2005).

The psychological aspects of aromatherapy. International Journal of Aromatherapy VOLUME 15 NUMBER 1 PUBLICATION DATE- 2005 PP 3-6

For many years, aromatherapists have largely ignored psychological factors that may be involved in, and play a part in their discipline. One possible explanation for this is that they feared they would add fuel to the already critical and disapproving attitude of the general medical profession that aromatherapy is just a pleasant experience at best, or, at worst, a scam ÝVickers A. Massage and aromatherapy: a guide for health professionals. London: Nelson Thornes; 1998¨. However, for a long time, medical professions have been content to admit that psychological effects, or what is commonly termed 'the placebo effect', play a large part in the effectiveness of the administration of drugs and even surgery.

Burnett, K.M., L.A. Solterbeck, *et al.* (2004).

' Scent and mood state following an anxiety-provoking task.' Psychological Reports 95(2): 707-722.

The purpose of this study was to assess the effects of water, lavender, or rosemary scent on physiology and mood state following an anxiety-provoking task. The nonsmoking participants, ages 18-30 years, included 42 women and 31 men who reported demographic information and measures of external temperature and heart rate were taken prior to introduction of an anxiety-eliciting task and exposure to lavender, rosemary, or water scents. Following the task, participants completed the Profile of Mood States to assess mood, and temperature and heart rate were reassessed. Participants rated the pleasantness of the scent received. When pleasantness ratings of scent were covaried, physiological changes in temperature and heart rate did not differ based on scent exposure, but mood ratings differed by scent condition. Participants in the rosemary condition scored higher on measures of tension-anxiety and confusion-bewilderment relative to the lavender and control conditions. The lavender and control conditions showed higher mean vigor-activity ratings relative to the rosemary group, while both rosemary and lavender scents were associated with lower mean ratings on the fatigue-inertia subscale, relative to the control group. These results suggest that, when individual perception of scent pleasantness is controlled, scent has the potential to moderate different aspects of mood following an anxiety-provoking task.

Campenni, C.E., E.J. Crawley, *et al.* (2004).

' Role of suggestion in odor-induced mood change.' Psychological Reports. Vol 94(3,Pt2): 1127-1136.

The effects of ambient odor (lavender, neroli or placebo) and suggestions related to the effects of an odor (relaxing, stimulating or none) on mood were explored. Mood of 90 undergraduate women was assessed using physiological measures (heart rate and skin conductance) and the self-report Profile of Mood States questionnaire. Analysis indicated that physiological measures were influenced by suggestion in predictable directions. Relaxing odors yielded decreases in heart rate and skin conductance, with stimulating odors yielding the reverse effects under equivalent conditions. These data further support the notion that expectations play a significant role in mediating odor-evoked mood changes. (PsycINFO Database Record (c) 2006 APA, all rights reserved) (journal abstract) DOI: doi:10.2466/PR0.94.3.1127-1136

Cheng, K.M., J.H. Xin, *et al.* (2001).

Colour planner for designers based on colour emotions. Proceedings of SPIE - The International Society for Optical Engineering, Rochester, NY.

During the colour perception process, an associated feeling or emotion is induced in our brains, and this kind of emotion is termed as ' colour emotion' . The researchers in the field of colour emotions have put many efforts in quantifying colour emotions with the standard colour specifications and evaluating the influence of hue, lightness and chroma to the colour emotions of human beings. In this study, a colour planner was derived according to these findings so that the correlation of colour emotions and standard colour specifications was clearly indicated. Since people of different nationalities usually have different colour emotions as different cultural and traditional backgrounds, the subjects in this study were all native Hong Kong Chinese and the colour emotion words were all written in Chinese language in the visual assessments. Through the colour planner, the designers from different areas, no matter fashion, graphic, interior or web site etc., can select suitable colours for inducing target colour emotions to the customers or product-users since different colours

convey different meanings to them. In addition, the designers can enhance the functionality and increase the attractiveness of their designed products by selecting suitable colours.

Classen, C., D. Howes, *et al.* (1994).

Aroma: The cultural history of smell.

(from the cover) ' Aroma' uncovers the secret history of smells: from the perfumed banquets of ancient Greece to the 'best blueberry flavour ever made,' from the sweet 'odour of sanctity' to the latest in designer fragrances. A journey of discovery that takes in the perfume potions of the Pacific as well as Andean aromatherapies, ' Aroma' maps the 'smellscapes' of different cultures and explores the roles that odours have played throughout history. Along the way, the authors open our senses to the powerful cultural meanings of smells. Odours, they show, inform power relations between the sexes, between classes and ethnic groups.

Coryell, J.A. (2003).

' The therapeutic use of color in a clinical environment.' Dissertation Abstracts International: Section B: The Sciences and Engineering. Vol 64(3-B).

Research has shown that color has the capacity to affect the human organism, both emotionally and physiologically (Goldstein, 1939; Terwogt & Hoeksma, 1995). Studies have also shown that the physical environment can influence an individual's experience while in that environment, in terms of their perceptions, behavior, overall sense of well being, and healing process (Chaikin, Derlega, & Miller, 1976; McKahan, 1993; Pressly & Heesacker, 2001). Color, as one element of a physical environment, has been intentionally incorporated into the physical space in medical and industrial contexts to enhance recovery and performance outcomes of its occupants. As the psychotherapeutic community has not seriously considered the use of color in the therapy room, this study reviewed the literature in both domains-color and physical environment-for the purpose of identifying how color can be used as a viable therapeutic tool in a clinical setting to enhance the therapeutic work. Characteristic responses to color were found to fall into two general categories, warm colors (red, orange, yellow) and cool colors (blue, green). Similarly, moods were conceived as falling into two general categories, anxiety and depression. A clinical frame was proposed for color applications with clients with mood symptomatology, whereby color is matched to mood to induce desired mood states. Intervention strategies, diagnostic utility, relevance to mood disorders, practical considerations, and the role of age, gender, cultural, and individual differences were discussed.

Dalton, P. (1996).

' Odor perception and beliefs about risk.' Chemical Senses 21(4): 447-458.

Although the perceptual response to environmental odors can be quite variable, such variation has often been attributed to differences in individual sensitivity. An information-processing analysis of odor perception, however, treats both the reception and the subsequent evaluation of odor information as determinants of the perceptual response. Two experiments investigated whether a factor that influenced the evaluation stage affected the judgement of odor quality and the degree of adaptation to the odor. People were surveyed in order to measure their tacit perceptions of the healthfulness or hazardousness of nine common olfactory stimuli, and the instructional context influenced quality perception. In a second experiment subjects were exposed to an ambient odor under one of three different conditions, and odorant characterization influenced the degree of adaptation to the odor. Subjects who were led to believe the odor was a natural, healthy extract showed adaptation; those told that the odor was potentially hazardous showed apparent sensitization; while those told that the odor was a common olfactory test odorant showed a mixed pattern: some exhibited adaptation, whereas others showed sensitization. However, detection thresholds obtained before and after exposure showed adaptation effects that are characteristic of continuous exposure. These findings raise the possibility that cognitive factors may be modulating the overall sensory perception of odor exposure (i) for some individuals who exhibit extreme sensitivity to odors and (ii) in situations where adaptation to environmental odors is expected but does not occur.

Diego, M.A., N.A. Jones, *et al.* (1998).
' Aromatherapy positively affects mood, EEG patterns of alertness and math computations.' Int J Neurosci. 1998 Dec; 96(3-4): 217-24.
EEG activity, alertness, and mood were assessed in 40 adults given 3 minutes of aromatherapy using two aromas, lavender (considered a relaxing odor) or rosemary (considered a stimulating odor). Participants were also given simple math computations before and after the therapy. The lavender group showed increased beta power, suggesting increased drowsiness, they had less depressed mood (POMS) and reported feeling more relaxed and performed the math computations faster and more accurately following aromatherapy. The rosemary group, on the other hand, showed decreased frontal alpha and beta power, suggesting increased alertness. They also had lower state anxiety scores, reported feeling more relaxed and alert and they were only faster, not more accurate, at completing the math computations after the aromatherapy session.

Dodd, G.H. and M. Skinner (1992).
From moods to molecules: The psychopharmacology of perfumery and aromatherapy.
(from the introduction) [examines how molecules within perfumes affect odor perception / discusses the role of aromatherapy in eliciting changes in mood] / present a review of perfumery molecules and discuss the phenomenon of key impact odorants / this idea refers to odours which at very low levels have been shown to be very active in terms of the total odour accord / argue that understanding of the receptor events in olfaction has become possible because of the huge investment in the general area of biological receptors–a topic of central interest in pharmacology and medicine(from the chapter) new approaches to structure-odour relationships / olfactory receptor mechanisms / placebo effects in perfumery and aromatherapy / electronic noses and perfume (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Ehrlichman, H. and L. Bastone (1992).
The use of odour in the study of emotion.
(from the chapter) discusses how odours can be profitably used to study emotional processes and the theoretical and methodological implications of this view /// effects of mood on cognition and behaviour / hedonic valence, affect and odour / effects of odours on cognitive processes / affect, odour, and the two hemispheres of the brain (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Ehrlichman, H. and J.N. Halpern (1988).
' Affect and memory: effects of pleasant and unpleasant odors on retrieval of happy and unhappy memories.' J Pers Soc Psychol. 1988 Nov; 55(5): 769-79.
Interpretation of studies of induced mood and memory is complicated by the fact that mood induction procedures may elicit mood-related cognition in addition to mood per se. We used odors to produce positive and negative experiences with minimal cognitive involvement. College women recalled memories cued by neutral words while exposed to a pleasant odor, unpleasant odor, or no odor. Subjects then rated their memories as to how happy or unhappy the events recalled were at the time they occurred. Subjects in the pleasant odor condition produced a significantly greater percentage of happy memories than did subjects in the unpleasant odor condition. When subjects who did not find the odors at least moderately pleasant or unpleasant were removed from the analysis, more pronounced effects on memory were found. The results suggest that congruence between the general hedonic tone of current experience and that of material in long-term memory is sufficient to bias retrieval.

Field, T., M. Diego, *et al.* (2005).
' Lavender fragrance cleansing gel effects on relaxation.' Int J Neurosci. 2005 Feb; 115(2): 207-22.
Alertness, mood, and math computations were assessed in 11 healthy adults who sniffed a cosmetic cleansing gel with lavender floral blend aroma, developed to be relaxing using Mood Mapping. EEG patterns and heart rate were also recorded before, during, and after the aroma session. The lavender fragrance blend had a significant transient effect of improving mood, making people feel more relaxed, and performing the math computation faster. The self-report and physiological data are consistent with relaxation profiles during other sensory stimuli such as massage and music, as reported in the literature. The data suggest that a specific cosmetic fragrance can have a significant role in enhancing relaxation.

Gao, X.P. and J.H. Xin (2006).

' Investigation of human's emotional responses on colors.' Color Research and Application 31(5): 411-417.
This article investigates human's emotional responses on colors based on a psychophysical experiment. Totally 218 color samples were evaluated by 70 subjects based on 12 basic descriptive variables including ' warm - cool,' ' weak-strong,' and ' dynamic-passive.' By using factor analysis, these 12 variables were split into two orthogonal factors (activity index and potency index) and one correlative factor (definition index), which may be used for description of color emotion. Based on these three indexes, a color emotion map in CIELCH color space was obtained by cluster analysis. A well-regulated distribution of human's emotion was observed in CIE L*C* plane with a neutral feeling region around the Point of chroma C*=30.5 and lightness L*=53.3. Colors scattered at opposite direction of this neutral region possess the opposite feelings. The detailed relationship between color emotion indexes and color perception attributes, i.e., hue, lightness, and chroma, were further studied by correlation analysis and graphical representation. The results indicated that the activity index was dependent on chroma, the potency index was dependent on lightness, and the definition index was dependent on both chroma and lightness. It was also observed that the influence of hue on emotional response was not as significant as those in previous studies even for the variable ' warm - cool.' © 2006 Wiley Periodicals, Inc.

Gedney, J.J.; Glover, T.L.; Fillingim, R.B. (2004).

Sensory and affective pain discrimination after inhalation of essential oils. Psychosomatic Medicine VOLUME 66 NO 4 2004 PP 599-606.
OBJECTIVE: The purpose of this investigation was to examine the effects of olfactory absorption of two commonly used therapeutic essential oils on sensory and affective responses to experimentally induced pain. METHODS: A sex-balanced (13 men and 13 women) randomized crossover design was used to obtain pre- and posttreatment change scores for quantitative sensory ratings of contact heat, pressure, and ischemic pain across separate inhalation treatment conditions using essential oil of lavender, essential oil of rosemary, and distilled water (control). Subjective reports of treatment-related changes in pain intensity and pain unpleasantness were obtained for each condition using a visual analog scale. We interpret our findings with respect to the separate dimensions of sensory and affective processing of pain. RESULTS: Analyses revealed the absence of changes in quantitative pain sensitivity ratings between conditions. However, retrospectively, subjects' global impression of treatment outcome indicated that both pain intensity and pain unpleasantness were reduced after treatment with lavender and marginally reduced after treatment with rosemary, compared with the control condition. CONCLUSION: These findings suggest that aromatherapy may not elicit a direct analgesic effect but instead may alter affective appraisal of the experience and consequent retrospective evaluation of treatment-related pain.

Gilbert, A.N., R. Martin, *et al.* (1996).

' Cross-modal correspondence between vision and olfaction: the color of smells.' Am J Psychol. 1996 Fall; 109(3): 335-51.
Cross-modal sensory correspondences between vision and audition have been well described, but those between vision and olfaction have not. In Experiment 1, a method previously used to relate color names, mood names, and line elements was replicated and extended to describe odors by color. Significant color characterizations were found for all 20 test odors. Test-retest correlations showed color-odor correspondences to be as stable as nonodor measures after 2 years. In Experiment 2, new subjects matched Munsell color chips to the test odors. Thirteen odors had characteristic hues; there was significant variation in chroma and value. The selected Munsell hues corresponded to the color names endorsed in Experiment 1. Together, these experiments suggest the existence of robust correspondences between vision and olfaction.

Hamid, P.N. and A.G. Newport (1989).

' Effect of color on physical strength and mood in children.' Perceptual and Motor Skills. 1989; 69(1): 179-185.
The physical strength and mood of creative production were measured for six preschool children under six coloured room conditions in an ABACAB design. Physical strength and high positive mood were demonstrated

in a pink-coloured room while the reverse was found in a blue-coloured room. The results were interpreted as supporting the differential arousal function of colours.

Han, J.D. and A. Uchiyama (2004).
' The Effect of Odor Presentation on Immune Function after Stress Loading.' Journal of International Society of Life Information Science. Vol 22(2): 574-576.
This research quantitatively analyzes the relaxation effect towards psychological stress among many stresses. Subjects were 10 healthy male adults, and physiological parameters were Heart Rate (HR), Systolic Blood Pressure (SBP), and Secretory Immunoglobulin A (SIgA). The Profile of Mood States (POMS) test was conducted to analyze the psychological condition, and the Uchida-Kraepelin test was used to load stress for 25 minutes. Majoram essential oil was used for the experiment. HR and SBP significantly decreased after presenting the oil odor for stimulation. SIgA concentration increased from the control value on presenting the odor. After a 20 minute recovery, SIgA was still significantly high ($p<0.05$). This suggested that this odor has a relaxation effect towards stress. (PsycINFO Database Record (c) 2006 APA, all rights reserved) (journal abstract)

Hatayama, T. (1999).
' Hedonic effects of fragrances.' Japanese Journal of Psychonomic Science. Vol 18(1): 107-112.
This article focuses on distinctive features of odor perception and its measurement before referring to hedonic effects on performance. Odors are closely connected to emotion in experimental findings that some specific chemicals activate olfactory receptors that generate neural messages sent to the olfactory centers sharing parts of the limbic system involved in emotional experience. Odors are said to influence mood, elicit intense experiences of pleasure or displeasure, and evoke remote emotional memories. The author suggests that the effects of fragrances might manifest themselves to some extent as a function of personal emotions: emotion systems might work as an internal moderator in the regulation of odor perception. This suggests that fragrances would have an indirect effect via some ' emotion filter' on the performance of tasks and mood. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Hemphill, M. (1996).
' A Note on Adults' Color-Emotion Associations.' Journal of Genetic Psychology 157(3): 275-280.
The color-emotion associations of undergraduate students were analyzed. Twenty men and 20 women were asked to complete a self-administered questionnaire in which they listed their favorite color, the major color they were wearing, their emotional responses to colors, and the reasons for their choices. Responses showed that bright colors elicited mainly positive emotional associations, and dark colors elicited mainly negative emotional associations. Women responded more positively than men to bright colors, and they also responded more negatively to dark colors. Comparisons are made between the color-emotion associations of children and those of adults. The reasons for the color-emotion associations are discussed.

Herz, R.S. (2002).
Influences of odors on mood and affective cognition.
(from the chapter) This chapter reviews a wide range of research that shows how odors can influence mood, cognition, and behavior. As background for this analysis, a discussion of odor-associative learning is provided. The topics covered then include the effects of odor exposure on (1) mood and specific emotions, (2) attitudes, work efficiency, and perceived health, (3) emotional memory, and (4) emotionally conditioned behavior. In addition to the behavioral evidence, neuroanatomic substantiation for the special relationship between odor and emotional associations is presented. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Herz, R.S. and T. Engen (1996).
' Odor memory: Review and analysis.' Psychonomic Bulletin & Review 3(3): 300-313.
We critically review the cognitive Literature on olfactory memory and identify the similarities and differences between odor memory and visual-verbal memory. We then analyze this literature using criteria from a multiple memory systems approach to determine whether olfactory memory can be considered to be a separate memory system. We conclude that olfactory memory has a variety of important distinguishing characteristics,

but that more data are needed to confer this distinction. We suggest methods for the study of olfactory memory that should make a resolution on the separate memory system hypothesis possible while simultaneously advancing a synthetic understanding of olfaction and cognition.

Herz, R.S., C. Schankler, *et al.* (2004).
' Olfaction, Emotion and Associative Learning: Effects on Motivated Behavior.' Motivation and Emotion. Vol 28(4): 363-383.
Two experiments were conducted to investigate emotional associative learning to odors and subsequent behavioral effects. In Experiment 1, participants experienced a frustration mood induction in the presence of an unfamiliar ambient odor and later worked on puzzle tests in a room scented with either the same odor, a different-odor, or no-odor. Participants in the same-odor condition spent significantly less time working on the tests than participants in the other conditions; however, test accuracy did not vary. To clarify the findings, Experiment 2 included a test-only control and an emotionally neutral same-odor conditions. Results were compatible with the conclusion that decreased time spent by participants in the negative-same-odor condition was due to emotions elicited by associative learning to the ambient odor, although alternative interpretations remain possible. These data extend our previous results with children and suggest that odors readily become associated to emotions and can thereby influence behavior. (PsycINFO Database Record (c) 2006 APA, all rights reserved) (journal abstract) DOI: doi:10.1007/s11031-004-2389-x

Heuberger, E., T. Hongratanaworakit, *et al.* (2001).
' Effects of chiral fragrances on human autonomic nervous system parameters and self-evaluation.' Chemical Senses 26(3): 281-292.
The effects of chiral fragrances (enantiomers of limonene and carvone) on the human autonomic nervous system (ANS) and on self-evaluation were studied in 20 healthy volunteers. Each fragrance was administered to each subject by inhalation using an A-A-B design. Individuals were tested in four separate sessions; in one session one fragrance was administered. ANS parameters recorded were skin temperature, skin conductance, breathing rate, pulse rate, blood oxygen saturation and systolic as well as diastolic blood pressure. Subjective experience was assessed in terms of mood, calmness and alertness on visual analog scales. In addition, fragrances were rated in terms of pleasantness, intensity and stimulating property. Inhalation of (+)-limonene led to increased systolic blood pressure, subjective alertness and restlessness. Inhalation of (-)-limonene caused an increase in systolic blood pressure but had no effects on psychological parameters. Inhalation of (-)-carvone caused increases in pulse rate, diastolic blood pressure and subjective restlessness. After inhalation of (+)-carvone increased levels of systolic as well as diastolic blood pressure were observed. Correlational analyses revealed that changes in both ANS parameters and self-evaluation were in part related to subjective evaluation of the odor and suggest that both pharmacological and psychological mechanisms are involved in the observed effects. In conclusion, the present study indicates that: (i) prolonged inhalation of fragrances influences ANS parameters as well as mental and emotional conditions; (ii) effects of fragrances are in part based on subjective evaluation of odor; (iii) chirality of odor molecules seems to be a central factor with respect to the biological activity of fragrances.

Heuberger, E., T. Hongratanaworakit, *et al.* (2006).
' East Indian Sandalwood and alpha-santalol odor increase physiological and self-rated arousal in humans.' Planta Med. 2006 Jul; 72(9): 792-800.
In Ayurvedic medicine, East Indian Sandalwood is an important remedy for the treatment of both somatic and mental disorders. In this investigation, the effects of inhalation of East Indian Sandalwood essential oil and its main compound, alpha-santalol, on human physiological parameters (blood oxygen saturation, respiration rate, eye-blink rate, pulse rate, skin conductance, skin temperature, surface electromyogram, and blood pressure) and self-ratings of arousal (alertness, attentiveness, calmness, mood, relaxation and vigor) were studied in healthy volunteers. Compared to either an odorless placebo or alpha-santalol, Sandalwood oil elevated pulse rate, skin conductance level, and systolic blood pressure. alpha-Santalol, however, elicited higher ratings of attentiveness and mood than did Sandalwood oil or the placebo. Correlation analyses revealed that these effects are mainly due to perceived odor quality. The results suggest a relation between differences in perceived odor quality and differences in arousal level.

Heuberger, E., S. Redhammer, *et al.* (2004).
' Transdermal absorption of (-)-linalool induces autonomic deactivation but has no impact on ratings of well-being in humans.' Neuropsychopharmacology 29(10): 1925-1932.
Essential lavender oil has a long tradition as a mild sedative in herbal medicine. Relaxing effects after inhalation have also been demonstrated for one of its main constituents, (-)-linalool. The aim of the present investigation was to determine the effects of this monoterpenoid alcohol on human physiological parameters (blood oxygen saturation, breathing rate, eye-blink rate, pulse rate, skin conductance, skin temperature, surface electromyogram as well as systolic and diastolic blood pressure) and assessments of subjective well-being. (-)-Linalool was applied to 14 healthy subjects by percutaneous administration. Inhalation of the fragrance was prevented by means of breathing masks. (-)- Linalool induced deactivation with respect to physiology, that is, a decrease of systolic blood pressure and a smaller decrease of skin temperature, compared to a corresponding control group receiving a placebo, but had no effects on subjective evaluation of well-being.

Higuchi, T., K. Shoji, *et al.* (2002).
' Smelling lavender and jasmine with advance information about their psychological effects: An examination of the placebo effect.' Tohoku Psychologica Folia 61: 1-10.
The present study tested whether or not the mood of an individual while smelling a fragrance was affected by having advance information that the fragrance possessed some mood-improvement effects. Participants were instructed to smell lavender and jasmine, which are considered to possess sedative and stimulating effects, respectively, in either of three conditions: with no information about the effects (no information), with advance information that the stimulus would make them feel relaxed (relaxing information) or with advance information that it would make them feel stimulated (stimulating information). The results showed that, while smelling lavender, participants in the relaxing information condition were significantly less stressed than those in the other conditions. When they smelled jasmine, by contrast, the participants in the no information condition were significantly more stimulated than those in the relaxing information condition. These findings suggested that the advance information can help achieve a sedative effect in the case of smelling lavender but that it negatively affected the stimulating effect of jasmine. Possible reasons for the different effects found between lavender and jasmine were discussed.

Hongratanaworakit, T. and C. Buchbauer (2004).
' Evaluation of the harmonizing effect of ylang-ylang oil on humans after inhalation.' Planta Medica 70(7): 632-636.
Scientific evaluations of the effects of fragrances on humans are rather scarce. The aim of this investigation was to study the effects of ylang-ylang oil (Cananga odorata, Annonaceae) on human physiological parameters and self-evaluation. Twenty-four healthy volunteers participated in the experiments. Fragrances were administered by inhalation. Physiological parameters recorded were skin temperature, pulse rate, breathing rate and blood pressure. Self-evaluation was assessed in terms of alertness, attentiveness, calmness, mood, relaxation and vigor. Additionally, fragrances were rated in terms of pleasantness, intensity and effect. The present investigation showed that ylang-ylang oil may be characterized by the concept of ' harmonization' rather than relaxation/sedation. Compared to an odorless placebo, ylang-ylang oil caused significant decreases in blood pressure and pulse rate as well as significant increases of subjective attentiveness and alertness. Correlational analyses revealed that the observed effects are mainly due to a subjective odor experience.

Hongratanaworakit, T. and G. Buchbauer (2005).
Human behavioral and physiological reactions to inhalation of sweet orange oil, Leuven, Belgium: International Society for Horticultural Science (ISHS).
The main objective of the present study was to investigate the effects of sweet orange oil (Citrus sinensis) on the physiological parameters and self-evaluation in 24 healthy human subjects following inhalation. Physiological parameters recorded were blood pressure, breathing rate, skin temperature, and heart rate. Self-evaluation was assessed in terms of alertness, attentiveness, calmness, mood, relaxation, and vigour. Additionally, the fragrance was rated in terms of pleasantness, intensity, and effect. Sweet orange oil caused

significant increases in heart rate as well as in subjective alertness, which are likely to represent a stimulating effect of the oil. These findings furnish scientific proof for the use of sweet orange oil in aromatherapy for the relief of mild forms of depression and stress in humans..

Itai, T; Amayasu, H; Kuribayashi, M; Kawamura, N; Okada, M; Momose, A; Tateyama, T; Narumi, K; Uematsu, W; Kaneko, S. (2005).
Psychological effects of aromatherapy on chronic hemodialysis patients. Psychiatry Clin Neurosci VOLUME 54 NUMBER 4 PUBLICATION DATE- 2000 Aug PP 393-7
Effects of aromatherapy (odorless condition, lavender, and hiba oil) on mood and anxiety were investigated in 14 female patients who were being treated with chronic hemodialysis. A control period consisting of natural hospital smells was established before each test session, and then aromatic test conditions were systematically evaluated for odorless conditions as well as aromatic conditions containing lavender and hiba oil aromas. The effects of aromatherapy were measured using the Hamilton rating scale for depression (HAMD) and the Hamilton rating scale for anxiety (HAMA). Hiba oil aroma significantly decreased the mean scores of HAMD and HAMA, and lavender aroma significantly decreased the mean scores of HAMA. The mean scores of HAMD and HAMA in an odorless condition were
not significantly different from those of the control conditions. These results indicate that in chronic hemodialysis patients hiba oil is an
effective, non-invasive means for the treatment of depression and anxiety, and that lavender alleviates anxiety.

Jellinek, J. S. (1997).
' Psychodynamic odor effects and their mechanisms.' Perfumer and Flavorist. 1997; 22(5): 29...41.
This review of the psychodynamic effects of fragrances and aromas covers the following aspects: mechanisms of action (quasi-pharmacological, semantic, hedonic valence and placebo), effects related to substance (specificity and intensity), effects related to people, effects related to stimulus context, effects related to external context, conscious control and experimental evidence. In the conclusions it is pointed out that there is a need for broader studies, mechanisms seldom act alone, and mechanisms can be used in parallel for the strongest effect on moods. Odours are unlikely to manipulate us in hostile settings against our will, but in the right environment, and aided by our own readiness or desire to be affected, they can influence mood, emotional state and mental disposition..

Kawamoto, R., C. Murase, *et al.* (2005).
' The effect of lemon fragrance on simple mental performance and psychophysiological parameters during task performance.' Journal of UOEH 27(4): 305-313.
The purpose of this study is to effectively utilize fragrance in order to form a comfortable working environment, for which we obtained necessary data. The subjects were 14 female students. We made them do addition work in laboratories with and without lemon fragrance, and investigated their task performances, physiological changes and mood conditions. Our results showed that, although the existence or nonexistence of fragrance did not affect their work efficiency, it was revealed that fragrance mitigated exhaustion and maintained vigor.

Kim, Myung-Ja; Nam, Eun-Sook; Paik, Seun (2005).
In The effects of aromatherapy on pain, depression, and life satisfaction of arthritis. Taehan Kanho Hakhoe Chi VOLUME 35 NUMBER 1 PUBLICATION DATE- 2005 Feb PP 186-94.
PURPOSE: The purpose of this study was to investigate the effect of aromatherapy on pain, depression, and feelings of satisfaction in life of arthritis patients. METHOD: This study used a quasi-experimental design with a non-equivalent control group, pre-and post-test. The sample consisted of 40 patients, enrolled in the Rheumatics Center, Kangnam St. Mary's Hospital, South Korea. The essential oils used were lavender, marjoram, eucalyptus, rosemary, and peppermint blended in proportions of 2:1:2:1:1. They were mixed with a carrier oil composed of almond (45%), apricot(45%), and jojoba oil(10%) and they were diluted to 1.5% after blending. The data were analyzed using an 2-test, Fisher's exact test, t-test and paired t-test. RESULT: Aromatherapy significantly decreased both the pain score and the depression score of the experimental group compared with the control group. However, aromatherapy didn't increase the feeling of satisfaction in life of the experimental group compared with the control group. CONCLUSION: The result of this study clearly shows

that aromatherapy has major effects on decreasing pain and depression levels. Based on our experiment's findings, we suggest that aromatherapy can be a useful nursing intervention for arthritis patients.

Kim, M.A.; Sakong, J.K.; Kim, E.J.; Kim, E.H.; Kim, E.H. (2005).
Effect of aromatherapy massage for the relief of constipation in the elderly. - MED 05-17 200515778557 JOURNAL NAME- Taehan Kanho Hakhoe Chi VOLUME 35
PURPOSE: The purpose of this study was to verify the effect of aromatherapy massage on constipation in the elderly. METHOD: This study for 10 day, employed a randomized control group pretest-posttest design. The experimental group received abdominal massage using essential oils with Rosemary, Lemon, and Peppermint, and the control group received a
placebo massage. To evaluate the effect of aromatherapy, the degree of constipation was measured using the CAS (constipation assessment scale) and the number of bowel movements per week. Data was analyzed by repeated measures of ANOVA using the SPSS program. RESULT: The score of CAS of the experimental group was significantly lower than that of the control group. In addition the average number of bowel movements in the experimental group was higher than that of the control group. The effect of aromatherapy lasted 2 weeks after treatment, while the placebo effect lasted 7.10 days after treatment. CONCLUSION: The finding of this study showed that aromatherapy helps relieve constipation in the elderly.

Knasko, S.C. (1992).
' Ambient odor's effect on creativity, mood, and perceived health.' Chemical Senses. Vol 17(1): 27-35.
In 2 sessions held 1 wk apart, 90 Ss (aged 18-35 yrs) completed a performance task involving creativity, 4 personality tests, and questionnaires concerning their mood, perceived health, and perceptions of the testing environment. In one session the testing room was scented with lemon, lavender or dimethyl sulfide (DMS); in the other session it was unscented. There were 15 women and 15 men in each odor condition. Fewer health symptoms were reported in the lemon condition on scented compared to unscented days. Ss in the DMS group were in a less pleasant mood than those in the lavender group on both scented and unscented days; the order in which Ss were exposed to DMS played a role in the mood findings. Differences in creativity performance were not significant, but relationships emerged between personality traits and the effect of odor on task performance. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Knasko, S.C. (1993).
' Performance, mood, and health during exposure to intermittent odors.' Arch Environ Health. 1993 Sep Oct; 48(5): 305-8.
The effects of intermittent bursts of pleasant, unpleasant, and no experimental odor on human task performance, mood, and perceived health were tested in this study. Odors did not influence any of these measures; however, subjects who had been exposed to the malodors reported retrospectively that they thought the odors had a negative effect on all of these factors. These findings have implications for the methodological design and interpretation of air quality studies.

Knasko, S. C. (1995).
' Pleasant odors and congruency: Effects on approach behavior.' Chemical Senses 20(5): 479-487.
Ninety subjects between the ages of 18 and 35 viewed 24 slides when the testing room was scented with no odor or one of two pleasant scents (baby powder or chocolate). Six slides were of babies, six were of chocolate items and 12 were control slides of pine trees or the Orient. In pilot testing the chocolate slides were rated as being congruent with the chocolate scent and incongruent with the baby powder scent; the baby slides were rated as being congruent with the baby powder scent and incongruent with the chocolate scent. Subjects viewed the slides at their own pace while a computer recorded how long each slide was viewed. During a second viewing, subjects rated the slides and answered questions about their own mood and health. Congruency did not play a role in the findings. Pleasant odors had certain effects compared to no odor (i.e. longer looking time, better mood and lower hunger ratings), while other effects were related to specific odors (i.e. arousal was highest in the chocolate condition and there were fewer health symptoms reported in the baby powder condition). These findings suggest that pleasant odors may have some general effects due to

their hedonic value, while associations individuals have with particular pleasant odors may influence other variables.

Knasko, S.C., A.N. Gilbert, *et al.* (1990).

' Emotional state, physical well-being, and performance in the presence of feigned ambient odor.' Journal of Applied Social Psychology. Vol 20(16, Pt 2): 1345-1357.

90 university students (aged 19-35 yrs) were led to believe that a scented vapor had been sprayed into the testing area and that the experimenter expected it to affect their performance. Ss predicted their performance on a clerical coding task and performed it along with a speed and accuracy task. Finally, Ss completed emotional state and physical symptomatology scales and rated the room's odor. Positive mood was enhanced by the suggestion of a pleasant odor. Contrary to expectation, Ss in the unpleasant condition predicted higher performance on the coding task than Ss in neutral or pleasant conditions. The highest number of negative physical symptoms was more common among Ss given a malodor suggestion than among those given pleasant or neutral odor suggestions. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Komori, T.,R. Fujiwara, M. Tanida, J. Nomura, M. Yokoyama, (1995).

M.Effects of citrus fragrance on immune function and depressive states. Neuroimmunomodulation VOL. 2 NO. 3 1995 PP. 174-180

In our previous experiments on animals evidence was found that citrus fragrance can restore the stress-induced immunosuppression, suggesting that citrus fragrance may have an effect on restoring the homeostatic balance. Since a dysregulation of the neuroendocrine and immune function is thought to be associated with psychosomatic or psychiatric disorders an attempt was made to restore their mental health by stimulation of one of the sensory systems. Fragrance (citrus was our choice) which comforts through stimulation of the olfactory system was applied to depressive patients. It was given to 12 depressive subjects and the results indicated that the doses of antidepressants necessary for the treatment of depression could be markedly reduced. The treatment with citrus fragrance normalized neuroendocrine hormone levels and immune function and was rather more effective than antidepressants.

Küller, R., S. Ballal, *et al.* (2006).

' The impact of light and colour on psychological mood: A cross-cultural study of indoor work environments.' Ergonomics 49(14): 1496-1507.

The aim of the study was to determine whether indoor lighting and colour would have any systematic impact on the mood of people working indoors. Earlier studies have mostly focused either on light, colour or windows in laboratory settings. The present study was carried out in real work environments at different seasons and in countries with different latitudes. A total of 988 persons completed all parts of the study. In the countries situated far north of the equator there was a significant variation in psychological mood over the year that did not occur in the countries closer to the equator. When all four countries were considered together, it became evident that the light and colour of the workplace itself also had an influence on the mood of persons working there. The workers' mood was at its lowest when the lighting was experienced as much too dark. The mood then improved and reached its highest level when the lighting was experienced as just right, but when it became too bright the mood declined again. On the other hand, the illuminance as measured in objective terms, showed no significant impact on mood at any time of the year. The relationship between mood and the distance to the nearest window was bimodal. The results also indicate that the use of good colour design might contribute to a more positive mood. It is suggested that in future research light and colour should be studied as parts of the more complex system making up a healthy building.

Kuroda, K., N. Inoue, *et al.* (2005).

' Sedative effects of the jasmine tea odor and (R)-(-)-linalool, one of its major odor components, on autonomic nerve activity and mood states.' Eur J Appl Physiol. 2005 Oct; 95(2-3): 107-14.

We investigated the effects of the odor of jasmine tea on autonomic nerve activity and mood states in a total of 24 healthy volunteers. We used the odor of jasmine tea at the lowest concentration that could be detected by each subject but that did not elicit any psychological effects. R-R intervals and the POMS test were measured before and after inhalation of the odors for 5 min. Both jasmine tea and lavender odors at perceived

similar intensity caused significant decreases in heart rate and significant increases in spectral integrated values at high-frequency component in comparison with the control ($P < 0.05$). In the POMS tests, these odors produced calm and vigorous mood states. We also examined the effects of (R)-(-)-linalool, one of its major odor components, at the same concentration as in the tea, and (S)-(+)-linalool. Only (R)-(-)-linalool elicited a significant decrease in heart rate ($P < 0.05$) and an increase in high-frequency component in comparison with the controls, and produced calm and vigorous mood states. Thus, the low intensity of jasmine tea odor has sedative effects on both autonomic nerve activity and mood states, and (R)-(-)-linalool, one of its components, can mimic these effects.

Kwallek, N., C.M. Lewis, *et al.* (1996).

' Effects of nine monochromatic office interior colors on clerical tasks and worker mood.' Color research and application 21(6): 448-458.

A pre- and post-between groups experimental design with nine treatment groups was conducted to determine the effects of interior office colors on subject's clerical task performance, mood, and color preference. A total of 675 subjects participated in the study. The dependent variables were proofreading performance tasks, six mood states, and color preference. Independent variables were nine office colors, two saturation levels (high or low), two value levels (dark or light), warmth or coolness of the colors, and gender. The data were analyzed by using multivariate analyses of covariance and analyses of variance. The results showed that subjects made significantly more proofreading errors in the white office than in the blue and red offices. Females performed significantly better than males. Moreover, the saturation of the colors seemed to be a salient predictor of differences between females and males. Females indicated more depression, confusion, and anger in low-saturated office colors (white, gray, beige), whereas males reported more depression, confusion, and anger in the high-saturated office colors (green, blue, purple, red, yellow, and orange). Further, subjects revealed that they would be least likely to work in the beige and white offices. Implications for future research on the effects of colors on office worker performance and mood are discussed. (C) 1996 John Wiley and Sons, Inc.

Kwallek, N., C.M. Lewis, *et al.* (1988).

' Effects of office interior color on workers mood and productivity.' Perceptual and Motor Skills. 1988; 66(1): 123-128.

The experiment was designed to examine the effects of a red versus a blue office environment on a typing task and mood. Empirical evidence in this area is sparse, but the prevailing view is that ' warm' colors are more arousing than ' cool' colors. The 36 paid subjects were given the task of typing business forms for 20 min. in either a monochromatic red or blue office space and then asked to fill out the Eight State Questionnaire. In the second half of the experiment, subjects either returned to the same-colored office or moved to the different-colored office where the same procedure was followed but with alternate business forms and an alternate form of the questionaire. Significant main effects found were for the number of errors made on the typing task; the subjects who moved to the different-colored office made more errors than those subjects who remained in the same-colored office. On the questionnaire, group differences were not statistically significant, but the mean anxiety and stress scores were higher for the subjects who remained in the red office, the mean depression score was higher for the subjects who remained in the blue office, and the mean arousal score was higher for those subjects who switched to the different-colored office.

Lee, Inn Sook; Lee, Gyung Joo (2006).

Effects of lavender aromatherapy on insomnia and depression in women college students. Taehan Kanho Hakhoe Chi VOLUME 36 NUMBER 1 PUBLICATION DATE- 2006 Feb PP 136-43

PURPOSE: The purpose of this study was to explore the effects of the lavender fragrance on sleep and depression in women college students. METHOD: Forty-two women college students who complained of insomnia were studied during a four-week protocol (control treatment week, 60% lavender fragrance treatment week, washout week, 100% lavender fragrance treatment week). All subjects were in the department of nursing in ' K' college and the study was a single blind repeated measurements experiment. For the duration of the study, weekly evaluations of sleep, patterns of sleep disturbance, severity of insomnia scale, self satisfaction with sleep, and severity of depression were performed. RESULT: Among sleep variables, length of time taken to fall asleep, severity of insomnia, and self satisfaction with sleep were improved for the

60%(p=.000, p=.000, p=.000) and 100%(p=.000, p=.000, p=.000) week while the severity of depression was improved only for the 100%(p=.002)week. CONCLUSION: According to the study results, it can be concluded that the lavender fragrance had a beneficial effect on insomnia and depression in women college students. Repeated studies are needed to confirm effective proportions of lavender oil and carrier oil for insomnia and depression.

Leichsenring, F. (2004).

' The influence of color on emotions in the Holtzman Inkblot Technique.' European Journal of Psychological Assessment 20(2): 116-123.

In this study, the influence of chromatic and achromatic color on emotions in the Holtzman Inkblot Technique (HIT) was tested empirically. Samples of normals (n = 30), patients With neurotic disorders (n = 30), borderline patients (n = 30), and both acute (n = 25) and chronic schizophrenics (n = 25) were studied with the HIT. A computerized investigation of verbally expressed emotions was performed by means of the ' Affective Dictionary Ulm' (ADU; Dahl, Holzer, & Berry, 1992), which was applied to the responses in the HIT. The effect of color was tested separately for cards containing red vs. non-red colors. According to the results, normals, patients with neurotic disorders, and borderline patients expressed love and anger significantly more often in response to cards containing red colors. For the non-red color cards neither an effect on love and anger, nor on anxiety and depression could be demonstrated. Furthermore, the chromatic cards of the HIT elicited significantly more different words given in response to a card than the achromatic cards. Again, this was true for normals, patients with neurotic disorders, and borderline patients, but not for schizophrenics. Structural ambiguity of the HIT cards correlated significantly negatively with the number of emotion words given in response to a card, again with the exception of schizophrenics. The latter result is discussed referring to the ' almost axiomatic rule' (Gunderson & Singer, 1975, p. 6) that borderline patients function adequately on structured tests but appear more seriously disturbed on less structured tests.

Levy, B.I. (1980).

' Research into the psychological meaning of color.' American Journal of Art Therapy. Vol 19(4): 87-91.

Conducted 2 studies that investigated whether there was a systematic relationship between color and emotional response using 69 Ss (mostly undergraduates). In Exp I, Ss reacted to 3 colors–an intense yellow, a pastel blue-violet, and a cool green with a blue cast–shown in sequence. Ss in the 2nd study were shown a light blue-green, a dark mustard yellow, and a scarlet-vermillion. All Ss indicated their reactions by completing the Profile of Mood States. Results indicate tht Ss responded with significant differences in patterns of emotions that depended on the color placed before them. For example, the blue-violet color was equated with sadness and fatigue, while the cool green hue aroused anger and a sense of confusion. Results are consistent with previous research that suggests that warm colors provoke active feelings, and cool colors are sedate. (12 ref) (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Lombion Pouthier, S., P. Vandel, *et al.* (2006).

' Odor perception in patients with mood disorders.' J Affect Disord. 2006 Feb; 90(2-3): 187-91.

BACKGROUNDS: Olfaction has obvious correlates with emotional processes but little is known about the several aspects of olfaction in psychiatric disorders characterized by mood disturbance. This research aims at pointing out the specificities of olfactory perception in patients in order to identify the specific cerebral impairments involved in these disorders. METHODS: Olfactory sensitivity, detection, identification, self-evaluation of intensity and pleasantness have been recorded in a control group of healthy subjects (N = 58) and in three sample populations admitted to a Psychiatry Department: depressive patients (N = 49), anorectic patients (N = 17), and patients suffering from addiction to alcohol or drugs (N = 21). RESULTS: Depressive patients have a poor sensitivity, poor detection abilities but over-evaluate the pleasantness of odors. Anorectic patients have a high sensitivity, over-evaluate the intensities of the odors but under-evaluate their pleasantness. Alcoholic/drug addicted patients showed impairments in identification. LIMITATION: This study does not identify inter-individual differences in olfactory perception. CONCLUSION: The psychiatric diseases, here at hand although every one of them may be characterized by depressive components, show diverging impairments in olfactory perception. When variations in sensitivity are usually attributed to peripheral cues, impairments in

emotional and cognitive aspects of olfaction are typically related to specific brain structures and processes which could be particularly involved in these diseases.

Ludvigson, H.W. and T.R. Rottman (1989).
' Effects of ambient odors of lavender and cloves on cognition, memory, affect and mood.' Chemical Senses. Vol 14(4): 525-536.
Exposed 72 college students to 1 of 3 odors (cloves, lavender, or no odor) while they completed memory, cognitive, and mood and affect assessments. One week later, each odor group was subdivided into the 3 odor conditions and the same tasks were administered. Lavender adversely influenced arithmetic reasoning in the 1st session. Ss' affective reactions to the experiment were more favorable with lavender present, while cloves decreased willingness-to-return. In the 2nd session, effects on cognitive functioning were not evident and effects on affect were complex. Relative to no-odor controls, Ss that had odor in at least 1 session expressed negative affect and unwillingness-to-return. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Marchand, S. and P. Arsenault (2002).
' Odors modulate pain perception: a gender-specific effect.' Physiol Behav. 2002 Jun 1; 76(2): 251-6.
Odors naturally provoke emotions that are pleasant or unpleasant. Prior studies have demonstrated the effects of pleasing odors on cognition and mood perception, but no studies have reported if they influence pain perception. In the present study, we measured the effect of, and relationship between, different odors on mood and experimental pain perception. Results show that odors significantly influence mood in both women and men. Compared to a neutral odor, pleasant odors produced a positive mood while unpleasant odors produced a negative mood. However, the effect of odor on pain was gender specific, as only women experienced the effects of odor on pain perception. Because no relationship was found between mood and pain perception, it could suggest that different mechanisms are involved in the emotional aspects of mood and pain perception. These results and their potential clinical implications are discussed.

Martin, G.N. (1996).
' Olfactory remediation: Current evidence and possible applications.' Social Science and Medicine. Vol 43(1): 63-70.
Several recent psychological investigations have suggested a significant role for olfactory stimulation in the alteration of cognition, mood and social behavior. These orthodox investigations have a common, if uneasy, relationship with the holistic practice of so-called aromatherapy. This paper reviews the therapeutic effects of odor on health-related behavior. It distinguishes 2 types of research activity, one which is quantitative and science- and medicine-based, the other which is qualitative and anecdote- and experience-based. Both of these endeavors are critically assessed and suggestions are made for improvement in methodology and experimental design. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Millot, J.L., G. Brand, *et al.* (2002).
' Effects of ambient odors on reaction time in humans.' Neuroscience Letters 322(2): 79-82.
The perception of odors is well identified as having strong emotional correlates. The effects of ambient odors on arousal level and task performance have also been suspected but remain poorly assessed in the literature. The present study compared the reaction times of subjects between ambient odor conditions (pleasant and unpleasant) and a no-odor condition. The results showed that the reaction time in simple tasks (responses to visual or auditory stimulation) significantly decreased in the ambient odor conditions (whatever the pleasantness of the odors) compared with the no-odor condition. These results underline the importance of the olfactory environment in human behavior. (C) 2002 Elsevier Science Ireland Ltd. All rights reserved.

Moss, M., J. Cook, *et al.* (2003).
' Aromas of rosemary and lavender essential oils differentially affect cognition and mood in healthy adults.' Int J Neurosci. 2003 Jan; 113(1): 15-38.
This study was designed to assess the olfactory impact of the essential oils of lavender (Lavandula angustifolia) and rosemary (Rosmarlnus officinalis) on cognitive performance and mood in healthy volunteers. One hundred and forty-four participants were randomly assigned to one of three independent groups, and

subsequently performed the Cognitive Drug Research (CDR) computerized cognitive assessment battery in a cubicle containing either one of the two odors or no odor (control). Visual analogue mood questionnaires were completed prior to exposure to the odor, and subsequently after completion of the test battery. The participants were deceived as to the genuine aim of the study until the completion of testing to prevent expectancy effects from possibly influencing the data. The outcome variables from the nine tasks that constitute the CDR core battery feed into six factors that represent different aspects of cognitive functioning. Analysis of performance revealed that lavender produced a significant decrement in performance of working memory, and impaired reaction times for both memory and attention based tasks compared to controls. In contrast, rosemary produced a significant enhancement of performance for overall quality of memory and secondary memory factors, but also produced an impairment of speed of memory compared to controls. With regard to mood, comparisons of the change in ratings from baseline to post-test revealed that following the completion of the cognitive assessment battery, both the control and lavender groups were significantly less alert than the rosemary condition; however, the control group was significantly less content than both rosemary and lavender conditions. These findings indicate that the olfactory properties of these essential oils can produce objective effects on cognitive performance, as well as subjective effects on mood.

Motomura, N., A. Sakurai, *et al.* (2001).

' Reduction of mental stress with lavender odorant.' Perceptual and Motor Skills 93(3): 713-718.
The effect of the lavender odorant on a Japanese version of Cox and Mackay's stress/arousal adjective checklist for three groups was studied, One group of 14 was placed into a (2- X 2- X 3-m) sound-protected room for 20 min. without the presentation of an odor, an analogous group of 15 received the odor oil, and one group of 13 received a nonstressful condition, Analysis suggested that lavender odorants were associated with reduced mental stress and increased arousal rate.

Nikitina, N.V. and L.P. Urvantsev (1988).

' Color testing approach to emotionality studies in neurotic patients.' Zhurnal Nevropatologii i Psikhiatrii Imeni S.S.Korsakova 88(12): 82-85.

Ou, L.C. and M.R. Luo (2006).

' A colour harmony model for two-colour combinations.' Color Research and Application 31(3): 191-204.
This study investigates harmony in two-colour combinations in order to develop a quantitative model. A total of 1431 colour pairs were used as stimuli in a psychophysical experiment for the visual assessment of harmony. These colour pairs were generated using 54 colours selected systematically front CIELAB colour space. During the experiment, observers were presented with colour pairs displayed individually against a medium gray background on a cathode ray tube monitor in a darkened room. Colour harmony was assessed for each colour pair using a 10-category scale ranging from ' extremely harmonious' to ' extremely disharmonious.' The experimental results showed a general pattern of two-colour harmony, from which a quantitative model was developed and principles for creating harmony were derived. This model was tested using an independent psychophysical data set and the results showed satisfactory performance for model prediction. The study also discusses critical issues including the definition of colour harmony, the relationship between harmony and pleasantness, and the relationship between harmony and order in colour. (C) 2006 Wiley Periodicals, Inc.

Ou, L.C., M.R. Luo, *et al.* (2004).

' A study of colour emotion and colour preference. Part I: Colour emotions for single colours.' Color Research and Application 29(3): 232-240.
This article classifies colour emotions for single colours and develops colour-science-based colour emotion models. In a psychophysical experiment, 31 observers, including 14 British and 17 Chinese subjects assessed 20 colours on 10 colour-emotion scales: warm-cool., heavy-light, modern-classical, clean-dirty, active-passive, hardsoft, tense-relaxed, fresh-stale, masculine-feminine, and like-dislike. Experimental results show no significant difference between male and female data, whereas different results were found between British and Chinese observers for the tense-relaxed and like-dislike scales. The factor analysis identified three colour-emotion factors: colour activity, colour weight, and colour heat. The three factors agreed well with those found by Kobayashi and Sato *et al.* Four colour-emotion models were developed, including warm-cool, heavy-light,

active-passive, and hard-soft. These models were compared with those developed by Sato *et al.* and Xin and Cheng. The results show that for each colour emotion the models of the three studies agreed with each other, suggesting that the four colour emotions are culture-independent across countries. (C) 2004 Wiley Periodicals, Inc.

Ou, L.C., M.R. Luo, *et al.* (2004).

' A study of colour emotion and colour preference. Part III: Colour preference Modeling.' Color Research and Application 29(5): 381-389.

In this study three colour preference models for single colours were developed. The first model was developed on the basis of the colour emotions, clean-dirty, tense-relaxed, and heavy-light. In this model colour preference was found affected most by the emotional feeling ' clean.' The second model was developed on the basis of the three colour-emotion factors identified in Part I, colour activity, colour weight, and colour heat. By combining this model with the colour-science-based formulae of these three factors, which have been developed in Part I, one can predict colour preference of a test colour from its colour-appearance attributes. The third colour preference model was directly developed from colour-appearance attributes. In this model colour preference is determined by the colour difference between a test colour and the reference colour (L*, a*, b*) = (50, -8, 30). The above approaches to modeling single-colour preference were also adopted in modeling colour preference for colour combinations. The results show that it was difficult to predict colour-combination preference by colour emotions only. This study also clarifies the relationship between colour preference and colour harmony. The results show that although colour preference is strongly correlated with colour harmony, there are still colours of which the two scales disagree with each other. (C) 2004 Wiley Periodicals, Inc.

Peretti, P.O. (1974).

' Color mood associations in young adults.' Perceptual and Motor Skills 39(2): 715-718.

Rappe, E. and S.L. Kivela (2005).

' Effects of garden visits on long-term care residents as related to depression.' Horttechnology 15(2): 298-303.

Depression is a major health problem among the elderly. Its prevalence is high among those in long-term care. Exposure to the garden environment may alleviate depressive symptoms, but there is little research evidence to confirm this hypothesis. In this study we investigated the perceived effects and meanings related to garden visits among older individuals living in long-term care and assessed whether there are associations between experiences from garden visits and self-rated depression. Data were gathered by surveying 30 elderly people living in Kustaankartano, a nursing home and service center for elderly people in Helsinki, Finland. Prevalence of self-rated depression was high; 46% of the participants were depressed. Both being in the garden and seeing it from the balcony and observing nature were of great significance for most of the participants. For more than half of the participants, visiting the garden improved mood, quality of sleep, and ability to concentrate; it generated feelings of recovery and promoted peace of mind. Affective effects of visiting the garden tended to be more pronounced among the depressed than among those not depressed. The depressed did not consider social interaction and participation in social activities very important for their well-being. Depression tended to be related to perception of the residents that they experienced hindrances and distresses associated with visiting the garden. Although there were indicative differences between the depressed and nondepressed participants in garden experiences, the results suggest that visiting the garden may affect the subjective well-being of both groups positively.

Retiveau, A.N., E. Chambers, *et al.* (2004).

' Common and specific effects of fine fragrances on the mood of women.' Journal of sensory studies 19(5): 373-394.

The effect of three pleasant fine women's fragrances on the mood of women was assessed. The three fragrances had similar hedonic values but different sensory characteristics. The fragrances elicited nonspecific effects on mood. All three fragrances' impact on mood was influenced by initial mood and lasted up to three hours, i.e., as long as the scent was still noticeable. Trends revealed that all three fragrances decreased

negative affect and increased vigor. Also, independent of their hedonic value, the three fragrances elicited specific mood patterns. With the ' woody citrus coniferous' scent, respondents experienced higher hostility and tension. The ' floral chypre citrus' fragrance decreased anger and confusion. The 'floral woody' scent had the lowest Total Mood Disturbance score and lowered depression, tension and confusion.

Rosenstein, L.D. (1985).
' Effect of color of the environment on task performance and mood of males and females with high or low scores on the Scholastic Aptitude Test.' Perceptual and Motor Skills. Vol 60(2): 550.
The effect of color of the environment on mood was correlated with sex and scores on the College Board Scholastic Aptitude Test (SAT) for 32 male and 32 female undergraduates. Ss with high and low SAT scores were differentially affected by the different colors (red, yellow, blue, or neutral) of the room in which they sat for 15 min while working on an anagram test. Ss' moods were also assessed on 3 mood scales. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Rottman, T.R. (1989).
' The effects of ambient odor on the cognitive performance, mood, and activation, of low and high impulsive individuals in a naturally arousing situation.' Dissertation Abstracts International. Vol 50(1-B): 364.

Rouby, C., B. Schaal, *et al.* (2002). Olfaction, taste, and cognition.
(from the cover) This book presents a multidisciplinary synthesis of the literature in olfactory and gustatory cognition. It is divided into sections, including linguistic representations, emotion, memory, neural bases, and individual variation. Leading experts have written chapters on many facets of taste and smell, including odor memory, cortical representations, psychophysics and functional imaging studies, genetic variation in taste, and the hedonistic dimensions of odors. The approach is integrative, combining perspectives from neuroscience, psychology, anthropology, philosophy, and linguistics, and is appropriate for students and researchers in all of these areas who seek authoritative reference on olfaction, taste, and cognition. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Schaie, K.W. (1961).
' A Q-sort study of color-mood association.' Journal of Projective Techniques 25: 341-346.
Individual differences are found to exist in the strength of association and relations between color and mood. ' A rationale for the use of response to color as a means of personality study is provided by showing that color associations conform to consistent group stereotoypes, but show a sufficiently wide range of individual differences.' From Psyc Abstracts 36:01:3HE41S. (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Schickinger, P. (1975).
' Intercultural comparison of emotional connotations of colours in the projective chromatic pyramids test by a factorial analysis.' COMPARACION INTERCULTURAL DE CONNOTACIONES EMOCIONALES DE COLORES DEL TEST PROYECTIVO 'PIRAMIDES CROMATICAS' A TRAVES DE UN ANALISIS FACTORIAL 30(136): 781-808.

Schifferstein, H.N.J. and I. Tanudjaja (2004).
' Visualising fragrances through colours: The mediating role of emotions.' Perception 33(10): 1249-1266.
To facilitate communication about fragrances, one can use the colours people tend to associate with their smells. We investigated to what extent odour-colour correspondences for fine fragrances can be accounted for by underlying emotional associations. Odour-colour matches and degree-of-fit judgments revealed that odours were matched to colours non-randomly. Matching colours differed mainly on blackness (brightness), and less on chromaticness (saturation) and hue. Furthermore, we found a consistent negative relationship between odour-colour degree-of-fit ratings and the difference between the odour scores and the colour scores on one of the emotion dimensions (pleasure). This suggests that emotional associations may partly underlie odour-colour correspondences.

Schiffman, S.S. (1992).
Aging and the sense of smell: Potential benefits of fragrance enhancement.
(from the chapter) examines the loss of fragrance perception in the elderly / there are three major classifications of olfactory losses: anosmia (no sense of smell), hyposmia (reduced sensitivity of smell), and dysosmia (distortion of normal smell) /// explores the ways in which compensatory fragrance enhancement offers potential benefits to meet the needs of the elderly / such benefits include: (1) promotion of relaxation and stress reduction, (2) elevation of mood and reduction of depression, (3) improvement of task performance, (4) retrieval of memories, (5) promotion of better human relations among persons with diverse backgrounds, (6) improvement of self concept, (7) modification of sleep, and (8) enhancement of sexuality /// the overlapping neural circuitry in the brain's limbic system for olfactory, emotional and motivational information and for memory provides a physiological basis for potential behavioral change in each of these areas (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Schiffman, S.S., M.S. Suggs, *et al.* (1994).
' Effect of pleasant odors on mood of males at midlife: Comparison of African-American and European-American men.' Brain Research Bulletin 36(1): 31-37.
The purpose of this study was to determine if daily use of colognes could elevate mood in middle-aged men. Sixty men ranging in age from 40 to 55 years participated in the study. Half were European-American and half were African- American. Mood ratings were obtained twice daily for 12 days using the Profile of Mood States questionnaire (POMS). The first 2 days of the experiment were used as baseline information to establish each man's mood prior to the administration of the colognes. The following 10 days of the study consisted of two conditions of 5 days each, the fragrance condition and the placebo condition. Main effects of condition (baseline, fragrance, placebo) were found for all POMS factors including tension, depression, anger, vigor, fatigue, and confusion, as well as for the Total Mood Disturbance score (TMD). The scores for the fragrance condition were significantly better than those for the baseline condition for tension, depression, anger, fatigue, and confusion factors, as well as for the TMD. Also, the scores for the fragrance condition were significantly better than those for the placebo condition for all factors and the TMD. There was a main effect for race, with European-American subjects having significantly worse scores for tension and fatigue and significantly better scores for depression than African-American subjects. An interaction was present between race and condition for the depression, vigor, and confusion factors. The main conclusion of this study was that use of pleasant odors improved the mood of males at midlife.

Shibata, S. and N. Suzuki (2002). ' Effects of the foliage plant on task performance and mood.' Journal of Environmental Psychology 22(3): 265-272.
In this study we investigate the effect of leafy plants on subjects' task performance and mood. As independent variables, two types of tasks and several room arrangements were used. There was an association or a sorting task and the room was arranged either with the plant placed in front of the subjects, to the side of the subjects, or with no plant placed in the room. Gender was also considered a's a variable for analysis. Undergraduate students (F = 63, M = 83) performed either the association task or the sorting task under one of the three room arrangements. The association task was to create no more than 30 words for 20 different items. The sorting task was to sort 180 index cards into Japanese syllabary order. As for the task performance, Room x Gender interaction was significant in the scores of the association task ($p < 0.05$). Male subjects working without plants performed worse than female subjects under the same conditions ($p < 0.01$). Moreover, the task performances of the male subjects using the front arrangement were higher than that of the male subjects working without plants ($p < 0.10$). It was concluded that,the presence of the plants affected the association task more than the sorting task, and male subjects more than female subjects. It was also suggested that the presence of the leafy plants might affects creative work positively. (C) 2002 Elsevier Science Ltd. All rights reserved.

Shibata, S. and N. Suzuki (2004).
' Effects of an indoor plant on creative task performance and mood.' Scandinavian Journal of Psychology 45(5): 373-381.

In this study, we investigated the effect of an indoor plant on task performance and on mood. Three room arrangements were used as independent variables: a room with (1) a plant, or (2) a magazine rack with magazines placed in front of the participants, or (3) a room with neither of these objects. Undergraduate students (M= 35, F= 55) performed a task of associating up to 30 words with each of 20 specified words in a room with one of the three room arrangements. Task performance scores showed that female participants performed better in view of the plant in comparison to the magazine rack ($p < 0.05$). Moreover, mood was better with the plant or the magazine rack in the room compared to the no object condition ($p < 0.05$). However, the difference in task performance was highly influenced by the evaluation about the plant or the magazine rack. It is suggested that the compatibility between task demand and the environment is an important factor in facilitating task performances.

Shimizu, K. (2000). ' The influence of aromatherapy on mood.' Aroma Research. 2000; 1(1): 50-54.
To study the influence of aromatherapy on mood, 3 experiments were designed. The first involved stimulation of the sense of smell, the second involved stimulation of the sense of touch, and the third involved stimulation of smell and touch. Mood was described and categorized, and sleep conditions were measured. Stimulation of smell-touch had more influence on all categories of mood and improved sleep compared with the stimulation of the sense of smell alone. Aromatherapy is effective for stress relief..

Sugawara, Y., Y. Hino, *et al.* (1999).
' Alteration of perceived fragrance of essential oils in relation to type of work: a simple screening test for efficacy of aroma.' Chemical Senses. 1999; 24(4): 415-421.
The perceptional change of fragrance of essential oils is described in relation to type of work, i.e. mental work, physical work and hearing environmental (natural) sounds. The essential oils examined in this study were ylang ylang, orange, geranium, cypress, bergamot, spearmint and juniper. In evaluating change in perception of a given aroma, a sensory test in healthy adult subjects was employed in which the perception of fragrance was assessed by 13 contrasting pairs of adjectives. Scores were recorded after inhaling a fragrance before and after each type of work, and the statistical significance of the change of score for 13 impression descriptors was examined by Student's t-test for each type of work. It was confirmed that inhalation of essential oil caused a different subjective perception of fragrance depending on the type of work. For example, inhalation of cypress after physical work produced a much more favorable impression than before work, in contrast to orange, which produced an unfavorable impression after physical work when compared with that before work. For mental work, inhalation of juniper seemed to create a favorable impression after work, whereas geranium and orange both produced an unfavorable impression then. From these studies, together with those conducted previously with lavender, rosemary, linalool, peppermint, marjoram, cardamom, sandalwood, basil and lime, it is concluded that the sensory test described here might serve not only as a screening test for efficacy of aroma but also as a categorized table for aroma samples which can act as a reference to each other when examining the relationship between mood change of odour and its physiological effects..

Svoboda, K.P.; Karavia, A.N.; McFarlane, V. (2002).
Case study: the effects of selected essential oils on mood, concentration and sleep in a group of 10 students monitored for 5 weeks. International Journal of Aromatherapy VOL. 12 NO. 3 2002 PP. 157-161.
This paper covers a study on the effects of essential oils on the mood of a person. Botanical and phytochemical descriptions of selected plant species, as well as their traditional and current medicinal uses are presented.

Tisserand, R. (1988).
Essential oils as psychotherapeutic agents.
(from the chapter) effects of essential oils on emotional states /// concepts of mood evocation with essential oils /// aromatherapy (PsycINFO Database Record (c) 2006 APA, all rights reserved)

Valdez, P. and A. Mehrabian (1994).
' Effects of color on emotions.' Journal of Experimental Psychology: General 123(4): 394-409.

Emotional reactions to color hue, saturation, and brightness (Munsell color system and color chips) were investigated using the Pleasure-Arousal-Dominance emotion model. Saturation (S) and brightness (B) evidenced strong and consistent effects on emotions. Regression equations for standardized variables were; Pleasure = .69B + .22S, Arousal = -.31B + .60S, Dominance = -.76B + .32S. Brightness effects were nearly the same for chromatic and achromatic colors. Blue, blue-green, green, red-purple, purple, and purple-blue were the most pleasant hues, whereas yellow and green-yellow were the least pleasant. Green-yellow, blue-green, and green were the most arousing, whereas purple-blue and yellow-red were the least arousing. Green-yellow induced greater dominance than red-purple.

Veverkova, L. (2002).

' Colour psychology: Experiencing colours and their preference.' Psychologie barev: Proz?i?va?ni? barev a jejich preference 46(1): 44-54.

Regarding the fact that the last study concerned with research in the field of colour psychology was published in the journal Czechoslovak Psychology in 1968, the author tried to sum up briefly the present approaches to study of colour psychology and the knowledge broughts by them. The author was interested first of all in the experience quality of colours, i.e. the relation of colours to feelings and personality mood. Two basic orientations in research in colour preferences dealt with the verification of basic theoretical problems of colour preference, later the research in the field of psychodiagnostic tests become the priority. The general rank of colour preferences was stated, although in the conditions of high inter-individual variability. In the study of relations of colour preferences to emotions was found that the experience of the colour in the given situation is conditioned by the personality and the mood. When using colours as psychodiagnostic tool, the associations to colours mapping the relations between the colour and the mental content were proved. The knowledge brought by the colour psychology makes possible to exploat the individual reactions to colours as the basic psychodiagnostic method aimed to the affectivity assessment.

Veverkova, L. C. O. R. V. L. F. F. U. P. K. O. C. R. (2002).

' Psychologie Barev: Prozivani Barev a Jejich Preference / Colour psychology: Experiencing colours and their preference.' Ceskoslovenska Psychologie. Vol 46(1): 44-54.

Regarding the fact that the last study concerned with research in the field of colour psychology was published in the journal ' Czechoslovak Psychology' in 1968, the author tried to sum up briefly the present approaches to the study of colour psychology and the knowledge brought by them. The author was interested first of all in the experience quality of colours, i.e., the relation of colours to feelings, personality and mood. Two basic orientations in research in colour preferences dealt with the verification of basic theoretical problems of colour preference; later the research in the field of psychodiagnostic tests became the priority. The general rank of colour preferences was stated, although with high interindividual variability. In the study of relations of colour preferences to emotions, it was found that the experience of a colour in a given situation was conditioned by personality and mood. When using colours as a psychodiagnostic tool, the associations to colours mapping their relations between the colour and the mental content were proved. The knowledge brought by colour psychology makes it possible to exploit the individual reactions to colours as a basic psychodiagnostic method aimed at affectivity assessment. (PsycINFO Database Record (c) 2006 APA, all rights reserved) (journal abstract)

Villemure, C., B.M. Slotnick, *et al.* (2003).

' Effects of odors on pain perception: deciphering the roles of emotion and attention.' Pain. 2003 Nov; 106(1-2): 101-8.

Emotions have been shown to alter pain perception, but the underlying mechanism is unclear since emotions also affect attention, which itself changes nociceptive transmission. We manipulated independently direction of attention and emotional state, using tasks involving heat pain and pleasant and unpleasant odors. Shifts in attention between the thermal and olfactory modalities did not alter mood or anxiety. Yet, when subjects focused attention on the pain, they perceived it as clearly more intense and somewhat more unpleasant than when they attended to the odor. In contrast, odor valence altered mood, anxiety level, and pain unpleasantness, but did not change the perception of pain intensity. Pain unpleasantness ratings correlated with mood, but not with odor valence, suggesting that emotional changes underlie the selective modulation of

pain affect. These results show that emotion and attention differentially alter pain perception and thus invoke at least partially separable neural modulatory circuits.

Warrenburg, S. (2002).

' Measurement of emotion in olfactory research.' ACS Symposium Series 825: 243-260.

Odors have a special link to the emotions that can be assessed by careful measurement. This chapter reviews research carried out to measure the emotional effects of odors both physiologically and using self-report methodology. Physiological monitoring of blood pressure, brain waves, various measures of the autonomic nervous system, and the startle reflex have demonstrated that pleasant versus unpleasant odors generally evoke a positive versus a negative emotional response. However, these methods have not successfully demonstrated a finer discrimination among different positive emotions, such as stimulation from relaxation. Various approaches to measuring moods, or self-reported emotions, are described. Issues relating to the dimensions and categories of mood are considered, as well as whether mood effects of fragrances are best measured in a before-after, a retrospective, or a forced-choice methodology. A simple, forced-choice technique is highlighted, called Mood Mapping®. It measures a respondent's mood association to a flavor or fragrance chosen from a set of 8 mood categories. Comparisons are made among different fragrances or flavors based on the distribution of mood votes across respondents. It has been used to screen hundreds of perfumery materials, as well as many more Living® flowers, fruits, and spices, commercial fragrances, and fragrances in development. A large database has thus been cataloged and incorporated into a perfumer's tool called the Consumer Fragrance Thesaurus. This tool gives guidance to IFF's creative staff in developing fragrances for aromatherapy based products, where moods are a principal concern, as well as other fragrances, where other attributes are of key interest (e.g., clean, fresh, etc.).

Warrenburg, S. (2005).

' Effects of fragrance on emotions: Moods and physiology.' Chemical Senses 30 SUPPL. 1.

Yotsuya, Yukiko; Sakurai, Akihiro; Motomura, Naoyasu (1999).

A psychophysiological study of lavender odorant. Memoirs of Osaka Kyoiku University Series III Natural Science and Applied Science VOL. 47 NO. 2 Jan., 1999 PP. 281-287

In the present experiment the effect of the lavender odorant to human beings was investigated. Japanese version of Cox and Mackay's stress / arousal adjective checklist (J-SACL), blood pressure, heart rate, stroop test, non-spatial working memory task and the computed electroencephalogr- aphy (cEEG) was performed before and after the lavender odorants stimulation. The results indicated that lavender odorants have an anti-stress effect and reduce the arousal state in J-SACL, although lavender odorants did not influence blood pressure, heart rate, stroop test and non-spatial working memory task. Furthermore, the power spectrum of theta 1 (F4) was increased and beta 1 waves in T3, O1, P4 and F4 were decreased in the lavender stimulated group. These results suggest that the lavender odorants reduce an electrophysiological arousal state.