Differences in Implicit and Explicit Attitudes towards Physical Attractiveness while Chemosignaling Disgust

Universiteit Utrecht

Marissa Heddes BSc (4196680)

Supervisor: Dr. I.M. Croijmans

Second Reviewer: Dr. H. Marien

Master program: Social, Health and Organizational Psychology

Date: 31-08-2019

Wordcount: 7376

Abstract

Chemosignaling, which is the use of olfaction to pick up social information from fellow human beings, is important concerning physical attractiveness. Disgust is shown to affects both the preference, which is the order in which an individual ranks potential romantic partners, as the choosiness, which is the responsiveness to potential mates and the amount of effort expended in choice, when finding a mate (Kavaliers, Ossenkopp & Choleris, 2019). However, little research has focussed on the difference between implicit and explicit attitudes on a potential mate's physical attractiveness. This study, therefore, focuses on the question: '*What are the differences between implicit and explicit attitudes towards physical attractiveness when chemosignaling disgust?'.* Since the domain of romantic feelings and physical attractiveness is laden with emotions, it is reasonable to assume that physical attractiveness is a gut-feeling and therefore, an implicit attitude (Eastwick, Eagly, Finkel and Johnson, 2011). A repeated measures design was used to conduct this research. Twenty-six heterosexual, non-smoking women participated in four experimental conditions. In every condition, a different odour was presented (no odour, neutral odour, masked odour, disgusting odour) while participants watched clips from a dating show. During these clips participants' pupil size was tracked with an eye tracker in order to measure emotional arousal. After every clip, questions about the male's attractiveness were asked. This study, in contrast to expectations, shows that only an unconsciously perceived odour will implicitly influence the perceived physical attractiveness of a potential mate. Nonetheless, in contrast to previous research, the presence of a disgusting odour does not implicitly and explicitly influence attitudes on physical attractiveness.

Introduction

Olfactory and Attitudes

The sense of smell has multiple purposes. It is used to detect whether something is edible and for avoiding environmental hazards (Stevenson, 2010). Olfaction is also used to pick up social information from fellow human beings (de Groot, Semin & Smeets, 2017). This process is called *chemosignaling*. Chemosignals are defined as "odoriferous molecular volatiles that emanated from the skin of a sender. Chemosignals could potentially be registered by a receiver via the olfactory epithelium in the nose" (de Groot, 2015, p.11). Neuroimaging studies show that body odours recruit social information processing regions (de Groot, Semin & Smeets, 2017). One of these regions is the mirror neuron system, which is involved in achieving a similar perspective between people during interaction. Therefore, human odours can influence interpersonal communication. Chemosignals are shown to communicate an array of social information, including an individual's identity, health status, sexual availability, personal predisposition, and emotional status (Cecchetto, Lancini, Rumiati, & Parma, 2019). It is thought that the basis of this process lies in learning, i.e., the learning hypothesis. This hypothesis states that "...(a) distinctive chemical profiles (i.e., a set of odorant molecules in a fixed ratio) (b) have consistently and reliably been experienced together with state- or trait-related information embedded in the larger context, such that a systematic association was forged between the chemical profile on the one hand and state- or trait-related contextual information on the other hand" (de Groot, Semin & Smeets, 2017, p. 310). Furthermore, Wilson and Stevensons (2006) showed with their odour object theory that humans are able to mentally store odour mixtures as objects. These mixtures are thus seen as one single template instead of a mixture of multiple odours. The templates are then triggered depending on the context of the situation, for instance with the smell of fire (de Groot, Semin & Smeets, 2017). This process makes humans aware of situations that are about to unfold, which is crucial in human survival.

Chemosignals are shown to be able to communicate stable characteristics, such as gender or age, as well as dynamic states, such as emotions (de Groot, Semin & Smeets, 2017). Odours can also, explicitly and implicitly, influence attitudes and behaviour (Holland, Hendriks and Aarts, 2005). Holland, Hendriks and Aarts conducted their research with the use of cleaning products. Participants were more eager to keep their direct environment clean when exposed to the odour of all-purpose cleaner. However, most research shows an implicit or explicit attitude, but do not make a distinction between implicit and explicit attitudes.

Explicit attitudes are more deliberate, while implicit attitudes are automatic (Gawronski & Bodenhausen, 2006). Gawronski and Bodenhaus (2006) argue that implicit and explicit attitudes should be understood in terms of their underlying processes. Implicit attitudes can be linked to associative processes. "These processes are automatic affective reactions resulting from the particular associations that are activated automatically when one encounters a relevant stimulus" (Gawronski & Bodenhausen, 2006, p. 693). Moreover, associative evaluations are not the same as truth values. Associative processes can be activated whether a person considers these evaluations as accurate or inaccurate. However, these evaluations do depend on the pre-existing structure of associations in memory and the external input stimuli. Explicit attitudes, on the other hand, can be seen as propositional processes. According to Gawronski and Bodenhausen (2006) "evaluations resulting from propositional processes can be characterized as evaluative judgments that are based on syllogistic inferences derived from any kind of propositional information that is considered relevant for a given judgment" (p.694). The most important feature is that these processes are dependent on truth values, since propositional processes' reflective system is assumed to transform inputs from the associative store to propositional format. Chemosignals are thus shown to have an influence on conscious and unconscious attitudes people can have.

Olfactory and Physical Attractiveness

One of the attitudes that can be formed are attitudes of other people. When it comes to human mate choice, body odour is essentially linked to physical attractiveness. Moreover, the absence of an unpleasant odour is a more critical predictor of physical attractiveness, than the presence of a pleasant odour (Luebke and Pause, 2015). When an odour is extremely unpleasant, it triggers disgust. Disgust is seen, according to Darwin (1998), as "a sensation... referring to something revolting, primarily in relation to the sense of taste, as actually perceived, or vividly imagined; and secondarily to anything which causes a similar feeling, through the sense of smell, touch, and eyesight" (p.254). Disgust affects both the preference, which is the order in which an individual ranks potential mates, as the choosiness, which is the responsiveness to potential mates and the amount of effort expended in choice, when finding a mate (Kavaliers, Ossenkopp & Choleris, 2019). As mentioned above, olfactory is critical in picking up cues about environmental hazards. Therefore, disgust does not only influence the perceived attractiveness of people, but also underlies the avoidance of, and aversive behaviours displayed towards, individuals and groups. This effect is seen in women's perception of male attractiveness. Women show more negative attitudes towards unfamiliar and /or lower quality

of males (Jones et al.,2013). Moreover, they also show less interest and decreasing interest in positive responses, when a male is of lower quality or unfamiliar.

However, mate choice and physical attractiveness do not only affect explicit attitudes. Since the domain of romantic feelings and physical attractiveness is laden with emotions, it is reasonable to assume that physical attractiveness is also a gut-feeling and therefore an implicit attitude (Eastwick, Eagly, Finkel and Johnson, 2011). According to Eastwick et al. (2011), multiple psychologists have preferred implicit measures, because they hypothesised that such measures might diverge from explicit ones under certain theoretically meaningful circumstances. For example, they showed that an implicit preference for physical attractiveness in a romantic partner did not correlate with the explicit preferences for physical attractiveness. This finding is interesting, because Pause, Ohrt, Prehn and Ferstl (2004) argue that chemosensory effects are processed more implicitly. Cecchetto et al. (2016) showed that even when body odours are not consciously perceived, for example when they are masked by other fragrances, chemosignals are still being received. Therefore, a difference can be expected between implicit and explicit attitudes towards physical attractiveness while chemosignaling.

A lot is known about the effect of chemosignaling disgust when it comes to physical attractiveness (Sodavari et al., 2014). In contrast, little is known about the relation between implicit and explicit attitudes towards physical attractiveness, when chemosignaling disgust. Therefore, this study will focus on the question: '*What are the differences between implicit and explicit attitudes towards physical attractiveness when chemosignaling disgust?'* By focusing on the differences between implicit and explicit attitudes, some gaps of existing research can be filled. Until now, researchers focused solely on the explicit attitudes towards attractiveness or implicit attitudes towards attractiveness when chemosignaling disgust. However, research on the differences in what people consciously think and feel (explicit) and what they unconsciously perceive (implicit) has not been carried out. Possibly, our mate selection is a more unconscious process than research expects until now. However, when both measures complement each other, it could in time give a more profound understanding of the underlying mechanisms. This study is aiming at giving more insight into these differences and will over all help gain a deeper understanding of the effect of odour on physical attractiveness and mate choice. Not only is this of scientific relevance, it is also of social relevance, because human interaction is one of the essential matters for people to survive (Kenrick, Griskevicius, Neuberg., & Schaller, 2010).

Current Study

Tybur, Lieberman, Kurzban and DeScioli (2013) propose a model with four different domains of disgust. The first domain, 'toxin avoidance', is based on the principle that people avoid ingestion of toxins and are therefore disgusted by bad tastes. The second domain is the 'pathogen disgust' domain. This domain makes that people avoid contact with infectious disease-causing organisms, which for example exist in bodily fluids, animals and decomposing or rotting organic matter. The 'moral disgust' domain is used for communicating and coordinating condemnation with other people. It keeps people away from behaviours likely to be condemned by others, such as lying, cheating or stealing. Lastly, the 'sexual disgust' domain is the domain which will be focused on in this study.

Sexual disgust is the avoidance of fitness-jeopardising sexual partners (Tyber et al., 2013). Sexual avoidance works through three mechanisms. The first is the "perceptual systems that take cues with genetic compatibility and mate value as input" (Tyber et al., 2013, p.72). This system takes cues as input from the outside world to check someone's mate value. One of these cues is odour (in the form of chemosignals). Penn (2007) also showed that an individual's genotype determines their stable and unique body odour. This makes people able to discriminate between individuals and potentially good or bad mates. The second mechanism is the 'intermediate system for integrating intrinsic quality and genetic compatibility' (Tyber et al., 2013, p.73). After the input of cues, the cues need to be assessed to make a mating decision. When the sexual value is below the threshold of what is acceptable for a mate, the system outputs a feeling of sexual disgust. In turn, sexual disgust will cause sexual avoidance. The last mechanism is the output, 'the evolved response to partners of low sexual value' (Tyber et al., 2013, p.73). This mechanism causes the behaviour an individual demonstrates when sexually avoiding someone. The state of sexual disgust is not permanently present. However, avoidance behaviour may fluctuate and can be shown by facial expression and withdrawal behaviours. Concluding, a cue (odour) which is perceived as disgusting can influence a potential mate's attractiveness. So, (**H1):** '*When presented with a perceptible disgusting odour, an individual will explicitly estimate a potential mate as less attractive*'. A disgusting odour can, additionally, also influence implicit attitudes. Cunningham, Forestell and Dickter (2013), showed that implicit attitudes are also negatively affected by induced disgust. Therefore, it is expected that **(H2): '***When presented with a perceptible disgusting odour an individual will implicitly estimate a potential mate as less attractive'.*

Li, Moallem, Paller and Gottfried (2007) show that social preferences are also dependent on influences from odours that slip awareness. Which is why it is expected that

(H3): *'When presented with a not perceptible disgusting odour, an individual will explicitly estimate a potential mate as less attractive'.* Furthermore, they also showed that not perceptible odours can influence implicit attitudes on physical attractiveness. Therefore, **(H4):** *'When presented with a not perceptible disgusting odour, an individual will implicitly estimate a potential mate as less attractive.*

However, a difference is to be expected between the implicit and explicit attitudes on physical attractiveness. Greenwald and Banani (1995) theorise in early theory that people can be unwilling to report mental contents. This is also seen in the lack of a correlation between implicit and explicit preferences for physical attractiveness in a romantic partner (Eastwick et al., 2011). Moreover, Nosek (2007) suggests that not all implicit-explicit relations correlate strongly. One of the moderators of this relationship are interpersonal factors. Self-presentation, which entails 'alternating a response for personal or social purposes' (Nosek, 2007, p.67), is one of these factors. Individuals can alter their explicit response to another individual's attractiveness due to possible social sanction. Furthermore, according to Eastwick and Finkel (2008), explicit romantic partner preferences express an individual's beliefs about the reasons why they might desire a potential mate. Individuals will consider whether some traits are desirable or undesirable. So, even when an individual considers someone implicitly attractive, it does not necessarily imply that they also find the same individual explicitly attractive. A difference can thus be expected between the spontaneous affect and the explicit reasons. Thus, **(H5):** *'A difference in relationship is expected between a disgusting odour and implicit attitudes on physical attractiveness, and the relationship between a disgusting odour and explicit attitudes on physical attractiveness".*

Previous research shows that the influence of body odour on attractiveness is essential for mate selection. The absence of a disgusting odour is even more important than the presence of a pleasant odour (Luebke and Pause, 2015). This study will therefore focus on the influence of a disgusting odour on attractiveness and mate selection. Furthermore, most research has focussed on explicit attitudes on attractiveness, while the current study will focus on both implicit and explicit attitudes on attractiveness.

Data and Methods

Participants

Twenty-six participants, between the ages of 20 and 25 (M= 21,81, SD=1,63) signed up voluntarily to participate at Utrecht University. All the participants were heterosexual, non-

smoking females. Participants were informed that the study involved odours and physical attractiveness of males. Only heterosexual females were recruited, because the females in the clips, which will be discussed below, would otherwise distract bisexual or homosexual females. Furthermore, non-smoking participants were recruited to make sure that the participants had a good sense of smell.

Design

A repeated measures design was used to test four experimental conditions within every participant. In every condition an odour was presented, and clips were shown from a dating show. The first two conditions were control conditions, which respectively were no odour and a neutral odour. The third and fourth condition were experimental condition, which respectively was a masked disgusting odour and a disgusting odour. By presenting the odours in this order, the disgusting odour, which was used in the mask, was not smelled beforehand. Therefore, participants were not familiar with the odour and were less likely to identify it in the mask. Furthermore, the smells became more intense in every odour condition. During these clips participants' pupil size was tracked with an eye tracker. After every clip, questions about the male's attractiveness were asked. Furthermore, additional questions for control variables were asked with a questionnaire.

Odours

To ensure that all the participants maintained the same distance between their nose and the odour, participants had to put their head into a chinrest. The container with the odour was then installed onto the chinrest. The containers were always placed at the same height as the participant's upper lip. The odours used in the experiment were a diluent for the no odour condition and *eugenol* (clove smell) for the neutral odour condition. The concentration of the neutral odour was 10% eugenol in a diluent. The experimental odour used was *3-Methylbutanoic acid*, or more commonly known as *Isovaleric acid*. Isovaleric acid is most commonly described as the smell of sweat (Zeng, Leyden, Lawley, Sawano, Nohara, & Preti, 1991), and generally perceived as unpleasant (e.g., Keller & Vosshall, 2016). The concentration of the odour was 10 ppm Isovaleric acid in a diluent. The odour for the third condition was composed of Isovaleric acid (10 ppm) with eugenol (10%) as mask. This masked odour is meaningful, because participants do not explicitly perceive the disgusting odour, while it is expected that they do so implicitly. Some pre-tests were conducted regarding the concentration levels. These tests showed that Isovaleric acid is smellable in the masked when the amount of

Isovaleric acid in the concentration was increased. However, when the amount was decreased, the disgusting odour was no longer perceivable when presented as a separate odour.

To check the assumed qualities of the four experimental odours, participants answered three questions about the odour valance, odour intensity and odour recognizability after the experimental procedure. Odour valance was measured between -4 (very unpleasant) and 4 (very pleasant). Odour intensity and odour recognizability were both measured on a scale from 0 (I smell nothing / totally not recognizable) to 7 (Strongest I have ever smelled / very recognizable). Table 1 shows that no odour and the neutral odour were both perceived as mostly neutral. The masked odour was also perceived, on average, as neutral. The disgusting odour was, as planned, perceived as disgusting, without being too intense. The scent of eugenol was perceived as more intense.

Table 1. *Descriptive of the Valance, Intensity and recognizability of the used odours.*

	N	**Mean**	**SD**	**Minimum**	**Maximum**
No odour (*diluent)*					
Valance	26	.12	.864	-3	2
Intensity	26	.73	.827	0	2
Recognizability	26	1.31	1.320	0	5
Neutral odour (*Eugenol)*					
Valance	26	.65	2.097	-3	4
Intensity	26	4.27	1.151	2	6
Recognizability	26	3.46	1.679	1	7
Masked odour (*Eugenol + Isovaleric acid)*					
Valance	26	.58	1.943	-2	4
Intensity	26	4.15	1.287	2	7
Recognizability	26	3.46	1.923	0	7
Disgusting odour (*Isovaleric Acid)*					
Valance	26	-2.19	1.059	-4	0
Intensity	26	3.42	1.447	1	7
Recognizability	26	3.38	1.675	0	7

Tasks and Questionnaires

Part of the task was presented with the program OpenSesame, except the mood/arousal questionnaire, which was carried out with a printed questionnaire. Furthermore, another task and questionnaire were conducted by the researcher. Every task and questionnaire were conducted in Dutch.

Attractiveness task. To measure the influence of disgust on explicit attractiveness, participants watched movie clips, without sound, from a dating show. Rhodes et al. (2011) showed that movie clips and static images do not differ when it comes to ratings of facial attractiveness. Therefore, movie clips were chosen as a visual stimulus, because it is a more realistic representation of real life. The clips contained scenes from 'First dates', which is a tv show that matches two people for a blind date. Every couple consisted of a man and a woman. In total, every participant watched sixteen clips, four per odour condition. Presentation of all clips was randomised, so every clip was presented in every odour condition. After watching the clip, a self-constructed scale about the attractiveness of the male was asked. Riggio, Widman, Tucker and Salinas (1991) showed that essential components of physical attractiveness are facial- and body attractiveness, overall attractiveness, perceived sympathy and the degree in which an individual wants to date the person in question. Therefore, five questions were asked about these subjects on a scale from 1, corresponding to 'extremely unattractive', to 7, corresponding to 'extremely attractive'. After every odour condition, the mood/arousal scale from Aarts and Dijksterhuis (2003) was completed, in case of bias by a participant's mood or arousal.

The attractiveness scale was conducted with the use of a scale consisting of five questions. These questions were: *(1)* 'Based on your impression of the man, to what extent do you think the man in the clip was attractive?', *(2)* 'Based on your impression of the man, to what extent do you think the man in the clip was sympathetic?', *(3)* 'Based on your impression of the man, to what extent do you think the man in the clip has an attractive face?', *(4)* 'Based on your impression of the man, to what extent do you think the man in the clip has an attractive body?', and *(5)* 'To what extent do you agree with the following statement?: I would like to date this man.'. Every question was answered on a seven-point Likert scale ranging from 1, corresponding to 'extremely unattractive/unsympathetic/disagree', to 7, corresponding to 'extremely attractive/sympathetic/agree'. To investigate the underlying structure of the scale, a factor analysis with a varimax rotation was conducted. One underlying factor, with Eigenvalue higher than 1, was identified (see table 2). This factor accounted for 72% of variance in the survey data. Furthermore, Cronbach's alpha suggested an internal consistency of $\propto$=.903, which is considered to be an indication of a reliable scale. All the questions were then averaged for every clip for every odour condition, and thereafter averaged for every odour condition.

Table 2. *Factor analysis for the attractiveness scale.*

Items	Factor loading
1. Based on your impression of the man, to what extent do you think the man in the clip was attractive?	.959
2. Based on your impression of the man, to what extent do you think the man in the clip was sympathetic?	.630
3. Based on your impression of the man, to what extent do you think the man in the clip has an attractive face?	.882
4. Based on your impression of the man, to what extent do you think the man in the clip has an attractive body?	.871
5. To what extent do you agree with the following statement? I would like to date this man.	.874

Odour awareness questionnaire. Part of the control variables is the degree of odour awareness an individual has. Therefore, the Odour awareness scale (OAS) from Smeets, Schifferstein, Boelema, and Lensvelt-Mulders (2008) was used. The questionnaire consists out of 38 items about odour awareness and health related questions and some demographic questions about the age, relationship status and education level of participants. Participants completed this survey on the computer, after the attractiveness task.

Discrimination task. At the end of the experiment the participants performed a discrimination task between the different odours, to ensure that they had a good sense of smell and the mask of the disgusting odour was successful. The task was conducted by the researcher and consisted of twelve different combinations. Every round consisted of two different odours that had to be distinguished. Participants smelled three containers containing odours, of which two were the same. Participants then had to report which of the three odours were the same. These rounds were randomised for every participant. At the end of the task a few questions about the valance, intensity and recognizability of the odours were asked, as discussed above.

Eye-tracking

For the implicit measurements, pupil size was tracked with an eye tracker. Bradley, Miccoli, Escrig, and Lang (2008) showed that pupil size will increase when people are emotionally aroused. Therefore, an increase in pupil size can be expected when people regard an individual

as attractive. Before the clip started a fixation point was shown for 2 seconds, to get a baseline measurement and to cancel out the effect of the previous video and questions. The pupil size of the participants was tracked every two milliseconds, using an eye tracker (Eye Tribe). This data was then, in Microsoft Excel, reduced to an average score in pupil size of the participants per fixation point and movie clip. Every clip and fixation point of every participant were then matched to the right odour conditions. In IBM SPSS Statistics 24 the data pupil size of every fixation point was then deducted for the pupil size of the corresponding clip. This resulted in a score of the difference in the pupil size between the start and the end of the clip for every odour condition. All these scores were averaged per condition.

Procedure

Participants were all tested in a lab at Utrecht University. At the start of the experiment, all participants signed an informed consent. The chinrest was adjusted to the participant's measurements and the eye tracker was calibrated. To ensure the participant's privacy, the experimenter left the room when the attractiveness task started. The experimenter entered the room after every odour condition to install a new container in the chinrest. After the attractiveness task, participants filled in the odour awareness questionnaire on the computer. Lastly, the participants were guided into a different room were the discrimination task was conducted. At the end of the experiment participants were thanked for their participation.

Data processing

Control variables: A few control variables were constructed. These variables were, the mood/arousal scale, the OAS, age, relationship status, and education level.

Following Aarts and Dijksterhuis (2003), the mood/arousal scale has three questions with a loading on mood and three question with a loading on arousal. Every question contains six questions with two differentiating feelings of mood or arousal on a 10-point scale. To test this structure, another factor analysis with varimax rotation was conducted. Two factors were identified (see table 3) and accounted for 74% of the variance in the questionnaire data.

Table 3. *Factor analysis for the mood/arousal scale.*

Items	Loading	
	Factor 1	**Factor 2**
1. Sad-happy	.817	.291
2. Bad- good	.850	
3. Displeased – pleased	.891	
4. Calm- excited		.900
5. Tired - energetic	.261	.875
6. Sedated – aroused	.510	.458

The factor analysis, however, does show some overlap in factors. The third question of arousal (sedated-aroused), has a higher loading on the mood scale. Therefore, it will be considered in the mood and arousal scale reliability tests. To test reliability for the scales Cronbach's alpha was conducted. The mood scale showed $\propto$=.743. However, when deleting the arousal question from the mood scale, Cronbach's alpha increased to $\propto$=.836, which is more acceptable. When testing reliability for the arousal questions, Cronbach's alpha was $\propto$=.670. A closer examination, however, again showed that Cronbach's alpha would increase to $\propto$=.794 when deleting the sedated-aroused question. Therefore, the sedated-aroused question was excluded from the questionnaire. The scales were conducted taking the mean of the three or two questions. Both scales were then deducted from the baseline measurement of the mood/arousal scale, for every odour condition.

The Odour Awareness Scale was also investigated further with a factor analysis with varimax rotation. However, contradictory to the findings of Smeets, Schifferstein, Boelema, and Lensvelt-Mulders (2008), eleven different factors were detected. This can be caused due to the limited number of participants and the great number of items on the scale. Cronbach's alpha was $\propto$=.779, which is considered adequate for research purposes.

Relationship status was recoded to a dummy variable with '1', corresponding to 'in a relationship', and '0' to 'single'. Furthermore, education level ("What is your highest completed education level?") was also recoded to a dummy variable with '1' being university and '0' being high school. All the other categories of this question had not been filled in.

Table 4 shows a descriptive overview of all the used variables in the model. Table 4 shows that slightly more than half of the participants are in a relationship and slightly more people do not have a University degree. Furthermore, the OAS scale shows that participants have an above average sense of smell (M=3.02). However, the minimum shows that there are participants present with a slightly less sense of smell of 2.42.

Table 4. *Main variables used in the implicit and explicit model.*

	N	Mean	SD	Minimum	Maximum
Implicit attractiveness					
No odour (condition 1)	25	289298.81	120862.15	101264.3	592339.00
Neutral odour (condition 2)	25	242630.65	127391.81	24187.80	555010.37
Masked odour (condition 3)	25	209733.77	140442.41	-13032.91	534307.89
Disgusting odour (condition 4)	25	258187.14	123009.58	14537.20	472395.19
Explicit attractiveness					
No odour (condition 1)	26	4.10	.362	3.40	4.90
Neutral odour (condition 2)	26	4.14	.559	3.10	4.95
Masked odour (condition 3)	26	4.04	.532	2.90	5.10
Disgusting odour (condition 4)	26	4.05	.516	2.65	4.95
Control variables					
OAS	26	3.02	.277	2.42	3.50
Mood					
Condition 1 (no odour)	26	-.67	.898	-2.67	1.00
Condition 2 (neutral odour)	26	-.50	.910	-2.33	1.33
Condition 3 (masked odour)	26	-.44	.717	-1.67	1.33
Condition 4 (disgusting odour)	26	-.23	.430	-.67	.67
Arousal scale					
Condition 1 (no odour)	26	-.71	1.856	-4.50	2.00
Condition 2 (neutral odour)	26	-.69	1.504	-4.00	2.00
Condition 3 (masked odour)	26	-.71	1.739	-4.50	2.00
Condition 4 (disgusting odour)	26	-.29	1.607	-4.00	3.50
Age	26	21.80	1.625	20	25
Relationship status	26	.58	.504	0	1
Education level	26	.35	.485	0	1

Before analysing the data, outliers and assumptions were checked. One participant was excluded from the eye tracker data, because of some technical issues. However, the participant was considered for the explicit model. Some outliers (3) were present in the implicit and explicit odour conditions. Two were present in the implicit no odour condition and one in the explicit disgusting odour condition. However, none of the cases were extreme outliers and kept in the data to ensure no data was lost. Furthermore, Mahalanobis distance showed no multivariate outliers, so no participants were excluded.

Both the implicit as explicit model is measured with a repeated-measure ANOVA. Assumptions check showed no abnormalities. To test the difference between the implicit and explicit measurements a paired sample t-test was conducted with standardized scores, for every odour condition, from the implicit and explicit measurements. The assumptions of the paired sample t-test were also met.

Results

Control Variables

The mood and arousal scale were tested separately in a repeated measures ANOVA. The mood scale showed that the sample had some significant mood changes between the odour conditions F (3,75) = 4.252, p=.008. Pairwise comparison showed that participant's mood in odour condition 1, no odour, (M=-.673, SD=.176) was significantly more negative than participant's mood in odour condition 4, disgusting odour, (M=-.231, SD=.084) with p=.021. The arousal scale did not show a significant result F (3,75) =2.041, p= .115.

Another way to measure and control for the sense of smell of participants, was the discrimination task. This task also showed if the created odours were distinguishable. These results were tested with the use of a chi-square test for goodness of fit. This way, the results showed if a participant was making a guess in discriminating the odours or could really tell the difference. Furthermore, it showed if the manipulation with the mask odour was successful. Results of the chi-square are shown in table 5.

Table 5. *Results of the chi-square test of the different odour combinations*

Odour combination	**Number of misses**	**χ^2**
No odour & Neutral odour	3	15.385**
No odour & Masked odour	4	12.462**
No odour & Disgusting odour	6	7.538*
Neutral odour & Masked odour	21	3.769
Neutral odour & Disgusting odour	1	15.385**
Masked odour & Disgusting odour	3	22.154**

** significant effect with p<.02*

*** significant effect with p < .001*

Table 5 shows that participants were not able to distinguish between the neutral and the masked odour χ^2 (2, N=26) =3.769, p=.152. Furthermore, it indicates that all other odours were distinguishable by the participants. However, it does show that the disgusting odour and the neutral odour were more difficult to discriminate with a lower chi-square of χ^2 (1, N=26) =7.538, p=.006.

Implicit Model

Hypotheses 2 and 4 were tested with a one-way repeated measures ANOVA. The four different implicit odour conditions were used as dependent variables in the model. Figure 1 shows the boxplots of the different conditions. The boxplots show that the median of the four odour conditions is roughly the same. Furthermore, the outliers on the no odour condition are present. However, the spread of the neutral odour and the masked odour condition is bigger than the other odour conditions.

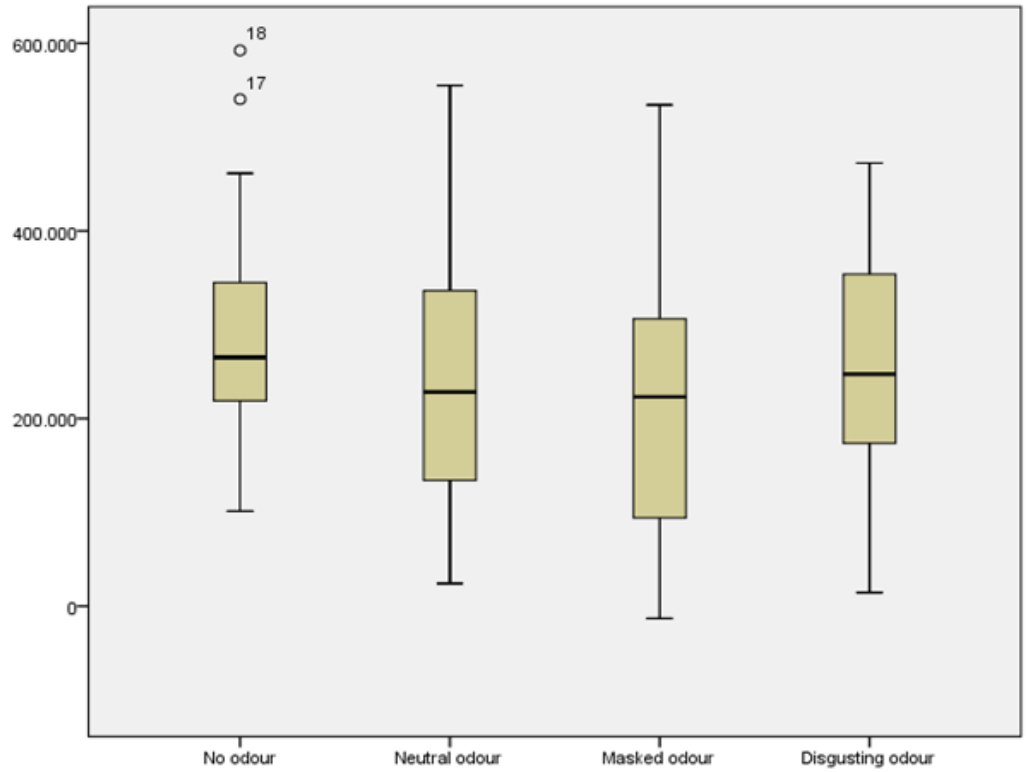

Figure 1. Boxplots of the four implicit odour conditions.

The ANOVA results show that the sample significantly preferred some conditions to others, $F(3,72) = 4.052$, $p=.010$, partial $\eta^2=.144$. Pairwise comparison further revealed that the no odour condition ($M=289298.81$, $SD=24172.43$) was preferred significantly more than the masked odour condition ($M=209733.77$, $SD=28088.48$). Therefore, hypothesis 4 can be assumed. Since there was no significant difference concerning the disgusting odour condition, hypothesis 2 is rejected.

Explicit Model

A repeated measures ANOVA was used to test hypotheses 1 and 3. The dependent variables were the four different explicit attractiveness scales for odour conditions. Boxplots of the different odour condition are shown in Figure 2. The figure shows that the no odour condition is a bit skewed and the spread is bigger on the masked odour condition. Furthermore, one outlier on the disgusting odour condition is present.

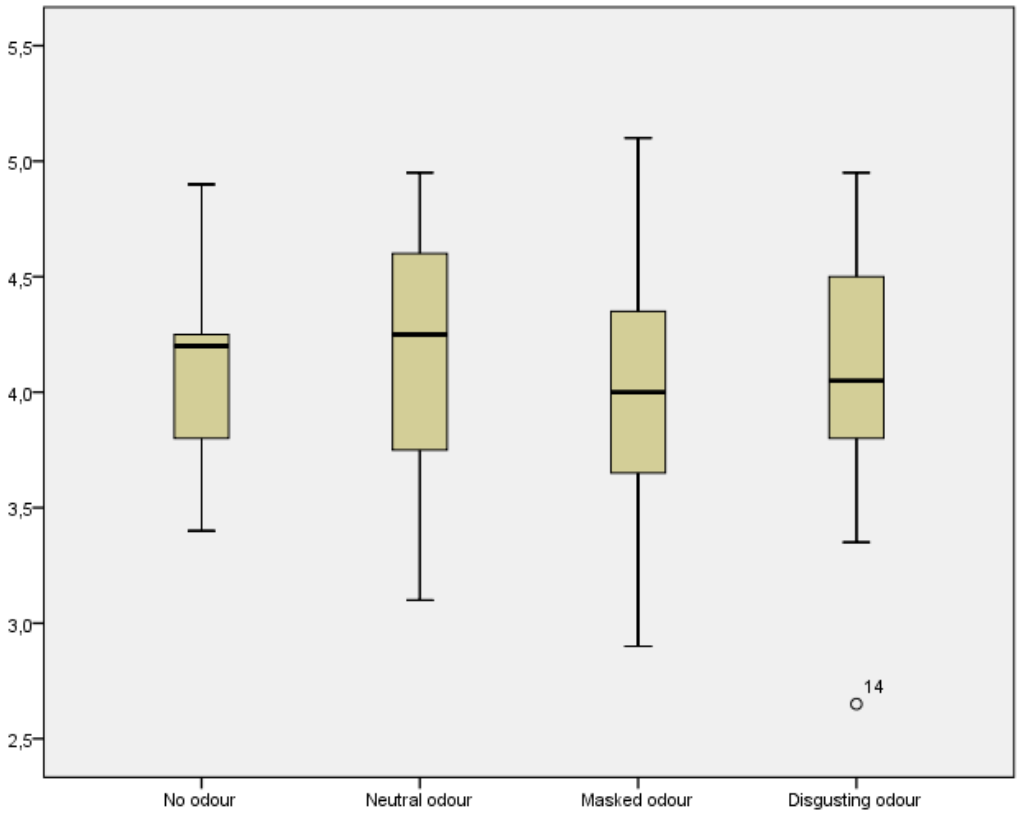

Figure 2. Boxplots of the four explicit odour conditions.

The results of the ANOVA showed no significant difference between the explicit odour conditions F (3,72) = .231, p=.874. Hypotheses 1 and 3 will, therefore, be rejected.

Difference Implicit and Explicit

Lastly, a paired sample t-test was used to test hypothesis 5. Only the implicit and explicit scores of the disgusting odour condition were compared. As mentioned in the method section, the eye tracker and attractiveness scale score were standardized to test if there is a difference between implicit and explicit attractiveness scores. The results between the implicit and explicit measurements of the disgusting odour condition showed no significant effect, t (24) = .312, p=.758. Hence, hypothesis 5 will be rejected.

Conclusion and Discussion

This study focussed on the differences and similarities between perceived attractiveness when chemosignaling disgust. After conducting an experiment with the use of an eye tracker, results show that the effects are not in line with theoretical expectations.

Contrary to the expectations, the presence of a perceptible disgusting odour does not influence the explicitly perceived attractiveness of a potential mate. Furthermore, the presence of a not perceptible disgusting odour does also not influence the explicitly perceived attractiveness of a potential mate. Since multiple previous studies, such as Li, Moallem, Paller, and Gottfried (2007) and Sodavari et al. (2014) show otherwise, it can be argued that something else is at play. An explanation can be sought in the control variables. The mood scale showed that participants were significantly happier at the end of the experiment. DeWall, Baumeister, Chester, and Bushman (2016) argued that mood influences people's social behaviour and judgement. This could explain why results are different than expected, since participants were influenced by their mood. However, DeWall et al. (2016) also state that the relationship between mood and social judgement is weak. It is, therefore, plausible that some other factors were also involved. Additionally, when looking at the chi-square results, a problem with the odours could also be the underlying problem. The results show, furthermore, that some participants were less able to discriminate between the no odour and disgusting odour condition. A total of six participants were not able to distinguish the no odour and disgusting odour. Since the total of participants was 26, six people is quite extensive (23%). Furthermore, the value of the chi-square also indicates a potential problem with the disgusting odour. The value of the chi-square is smaller than the values of the other odour condition, except for the mask. Therefore, it could be the case that the disgusting odour was not intense enough to report a significant difference between the odour conditions, possibly explained by the fact that the masking odour (eugenol) also had to be able to mask the disgusting odour. Furthermore, a very intense disgusting odour would potentially not be ethical. Further research could, therefore, focus on different odour concentrations or use different odours. Another explanation could be that not all movie clips were equally present in every odour condition. All clips were shown to participants in a randomised order. However, since the sample size was on the small side, the randomisation was not as effective as it would be with a larger sample size. Therefore, additional research is advised with a bigger sample size.

Contrary to the explicit findings, some implicit findings were significant. The implicit model showed that an individual, when presented with a perceptible disgusting odour, will not implicitly estimate a potential mate as less attractive. This, again, shows that there probably was an issue with the disgusting odour. However, results show that when presented with a not perceptible disgusting odour, an individual will implicitly estimate a potential mate as less attractive. This indicates that when a disgusting odour is masked, for example by perfume, an individual will still implicitly evaluate a potential mate as less attractive. However, the masked

odour, as mentioned above, is not significant in the explicit model. An explanation could be that explicit attitudes are more deliberate than implicit attitudes. When judging more deliberate and with reason, people might find others attractive because of other reasons that physical attractiveness. Since the visual stimulus was a movie clip, some nonverbal cues of a potential mate's attractiveness could be seen. Moreover, there is a possibility that participants looked at nonverbal cues when answering one of the questions in the attractiveness scale ('Based on your impression of the man, to what extent do you think the man in the clip was sympathetic?').

However, the last model showed that there are no significant differences between a disgusting odour and implicit attitudes on physical attractiveness, and the relationship between a disgusting odour and explicit attitudes on physical attractiveness. This shows that there might not be a difference in explicit and implicit attitudes, contrary to the reasoning above. However, a majority of these differences are still unknown and should, therefore, be further researched.

When interpreting these results, a few limitations should be kept in mind. Firstly, the movie clips that were used as a visual stimulus also contained a woman as part of the dating couple. Since Chivers, Rieger, Latty, and Bailey (2004) showed that heterosexual females experience strong sexual arousal towards males and females, participants could be distracted by the female, when watching the clips. Furthermore, nonverbal cues could be picked up from the woman as well as the man in the clips. This could have caused a bias in the judgement of the man. However, moving images are more natural than static images. Nevertheless, some additional research with different visual stimuli could be conducted.

Secondly, as already mentioned above, the sample size was a bit on the small side. This causes poor randomisation and low statistical power. Therefore, additional research should be conducted with a larger sample size to examine the differences between implicit and explicit attitudes towards physical attractiveness, when chemosignaling disgust.

This study showed that only an unconsciously perceived odour will implicitly influence the perceived physical attractiveness of a potential mate. Nonetheless, in contrast to previous research, the presence of a disgusting odour does not implicitly and explicitly influence attitudes on physical attractiveness. Some of the differences in the finding are not entirely explainable. However, counterarguments are also necessary in research. This study shows the importance of more research on this subject to deeper understand the underlying processes of chemosignals on physical attractiveness. Therefore, it is essential for further research to focus on duplicating this study to compare outcomes and find explanations for some gaps in research

about chemosignaling disgust and physical attractiveness. All in all, this study provides researchers with a different view on already existing research, while also encouraging for further research to understand the influence of a disgusting odour on implicit and explicit attitudes on physical attractiveness even more.

Acknowledgement

I would like to thank my supervisor Dr. Ilja Croijmans, from the department of Social, Health and Organisational Psychology, for all his guidance and helpful comments during my research.

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