

An Explorative Research to the Relation between Bitterness Acceptance and Disgust Sensitivity.



Universiteit Utrecht

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Janneke Derksen (5563372)

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Abstract.

In the present study is investigated whether or not there is a relation between bitterness acceptance and disgust sensitivity. An online quantitative study is conducted to answer this question. Two hypotheses were tested. Namely, whether there is an negative relation between bitterness acceptance and disgust sensitivity and whether experience with a bitter substitute an influence has in this relation. The data for this correlational design was collected via an online questionnaire ($N= 497$) which was distributed online. The results of three different multiple regressions showed no relation between bitterness acceptance and disgust sensitivity.

However, it seems that experience has an influences on the acceptance of bitter. There was a positive relation between bitterness acceptance and beer knowledge and a positive relation between bitter beer acceptance and drinking more different types of beer. Further research could investigate the role of experience more deeply.

Keywords: bitterness acceptance, disgust sensitivity, moral disgust, sexual disgust, pathogen disgust, beer, age, knowledge, experience.

Introduction

Not much research is done on the possible relationship between acceptance of bitterness and disgust sensitivity. This thesis is an exploratory study to this relationship.

Bitter is one of the five known flavours. The other flavours are sweet, salty savoury and umami. In order to taste flavours, humans depend on taste cells that transform information to the gustatory nerves and subsequently to the central nervous system. This is why humans can taste the sweetness of sugar, the bitterness of coffee, the sourness of a lime and the saltiness on fries. Out of all these five flavours, most research has focused on bitterness and its function or purpose.

Bitterness. A lot research has been done on the function of bitterness. One of the reasons is because bitter tastes are so important in warning animals to potential dangers in nature. Behrens et al. (2004), for example, have found that bitter receptors function as a warning sign to animals to reduce their intake of toxic substances. Animals use their sense of taste to determine whether or not food is safe to consume. They are able to detect bitter tastes in plants so as not to eat harmful toxins. Bitterness, in other words, functions as a warnings system.

This research is accompanied by the theory that in earlier days the main idea of bitterness a warning was for toxicity. According to Breslin's (2013) research, taste played a role in ensuring survival, as taste can identify safe food. If food tasted bitter, it was associated with toxicity and poison. And therefore not consumed. This reaction of bitterness is called the bitterness rejection.

Glendinning (1994) has done research the accuracy of the bitterness rejection. He expected the rejection threshold for a to a highly toxic mixture to be lower in comparison to a

nontoxic mixture. The results of his research revealed no relationship between the bitterness rejection and the avoidance of a toxic compound.

Nissim, Dagan-Wiener and Niv (2017) have done research on toxic compounds and investigated if these toxic compounds are generally bitter. Their research showed that a number of toxic compounds are not bitter and, many bitter compounds have negligible toxicity while having important health benefits. Therefore, this study concludes that not all bitter compounds have a documented toxicity. Approximately 60% of bitter bitter tasting molecules are toxic and only 56% of the known toxic compounds taste bitter. Take this altogether, bitter compounds are not a trustworthy marker for toxicity.

Bitter acceptance. Although bitter is not a trustworthy marker for toxicity, people still react to tasting a bitter compound. However people differ in the reactions of tasting bitter. This reaction is due to the difference in bitterness acceptance. This is the case for a number of reasons. Firstly, people respond in different ways because of the different levels of bitter intensity experienced to a bitter stimulus. Some people can detect bitter compounds in small amounts while others need a much bigger dose. The gene responsible for bitter taste detection is TAS2R38 (Mennella, Pepino, Duke, & Reed, 2010).

A second reason why people differ in bitterness acceptance is age. It seems that younger subjects are more sensitive for bitterness in comparison to older subjects. According to Mennella et al. (2019) sensitivity to bitterness changes across a person's lifespan. This change appears due to an alteration occurring to a person's genotype with the bitter receptor TAS2R38. What exactly happens during this alteration in taste sensitivity is unknown.

Gender is a third reason why people differ in bitterness acceptance. According to research of Michon, O'SULLIVAN, Delahunty, & Kerry (2009) gender has an impact on most sensitivity types and that females have an advantage in identifying a bitter taste. This

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research has also shown that woman can detect a higher intensity of both bitter and sweet concentrations than males do.

Experience is a fourth reason why people differ in bitterness acceptance. Stein, Nagai, Nakagawa, & Beauchamp (2003) did research to the effects of repeated exposure and health related information in hedonic evaluation and acceptance of a bitter beverage. In this research, participants consumed a bittersweet beverage in a setting they chose themselves for seven days. After the seven days the participants returned to the laboratory for post-exposure testing. Results of the hedonic rating were increased by 68%. For the control group, who had been drinking the same bittersweet beverage for the same number of days, the hedonic rating for the beverage had not changed. The researchers conclude that repeated exposure can improve the hedonic judgement of a bittersweet beverage. This may be due to a possible combination of flavor and post-ingestive effects and context. It can be concluded from this experiment that consuming a bittersweet beverage in a self-chosen context has a positive influence on bitterness acceptance as individuals learn to appreciate some bitter food.

A fifth reason that accounts for varying degrees of bitterness acceptance is due to avoidance tendencies as a result of disgust. Disgust is a distinctive emotion which is easily evoked by a simple smell, sound, sight or word (Inbar, Pizarro, Knobe & Bloom, 2009). There is a growing consensus that disgust plays a key role in motivating behaviour that most likely cuts down an individual's exposures to germs. As such disgust is associated with general avoidance tendencies. These findings have broad implications for the role of disgust. In shaping people's worldview and attitudes, in addition to disease avoidance (Shook, Thomas & Ford, 2019).

Disgust sensitivity. Disgust is a general tendency to respond with the emotion of revulsion to any given situation (Van Overveld, De Jong, Peters, Cavanagh, & Davey, 2006).

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This emotion is also linked to sexual intercourse, sexual arousal and mate preferences; eating and food preference; judgement and decision-making; and hygiene and health behaviour (Al-Shawaf, Lewis, & Buss, 2018). Research to disgust has shown there is a difference between males and females in disgust sensitivity. Females show a considerably higher level of disgust in comparison to men (Al-Shawaf, et al., 2018).

There are different domains of disgust. Scholars Tybur, Lieberman, & Griskevicius (2009) distinguish three domains; pathogen, sexual and moral disgust. The three different types are based on an adaptive viewpoint and suggests that evolution has favored three useful specialized domains. The first domain, pathogen disgust, is linked to pathogen avoidance. In other words, pathogen is a tendency to avoid objects that contain infectious agents, for example dead bodies, rotting fruits or bodily fluids such as feces, phlegm, vomit, blood and semen. Pathogen disgust functions to detect infections and microorganisms and also motivates individuals to avoid exposure to pathogen.

The second domain of disgust by Tybur et al. (2009) is sexual disgust. Sexual disgust functions to shield an individual from potentially harmful sexual behaviors that can negatively impact the gene pool. Sexual disgust thus narrows the scope of sexual behaviour and contribute to the production of healthy viable offspring. This disgust subgroup is different from pathogen disgust because this kind of disgust makes sure to avoiding sexual partners and to avoiding behaviors that potentially jeopardize one's reproductive success.

The third group of disgust is moral disgust. Schaich Borg, Lieberman, & Kiehl (2008) have researched the relation between moral judgement and disgust. Their research revealed that pathogen acts, sexual acts and social moral violations acts all activate a network of brain regions which are previously reported to be associated with disgust. Moral disgust is not only used descriptively or rhetorically to describe social trespassing, but also show a response

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towards different factors which include infection, incest, and iniquity. Moral disgust is described as the motivation to avoid social relationships with norm-violating individuals (Tybur et al., 2009). Each of these domains cover a different part of disgust and together create a different behavioral pattern. To avoid different types of potentially harmful behaviours.

Research question.

All of the information above describes why people differ in bitterness acceptance and why this bitterness acceptance in people differ. These reasons are because of bitterness intensity, age, gender experience and disgust sensitivity. In general, bitterness is regarded as an unwelcome taste in food and beverages, still a part of the population ingest items with a notable bitter taste (Mattes, 1994). It naturally follows to question why people consume bitter food and beverages, including bitter beer, although they are generally regarded as unpleasant. This thesis poses the following research question: What is the relation between bitter food acceptance, including beer, disgust sensitivity and experience with bitter food products? Two hypotheses are investigated. The first hypothesis states that there is a negative relation between bitterness acceptance and disgust sensitivity. The second hypothesis is states that experience with a bitter substitute has a positive effect on bitterness acceptance.

Methodology

Participants and Design

The study sample consisted of 662 participants who started the questionnaire. However, not all participants finished the questionnaire or dropped out early. In sum, 497 participants (75.1% of the registered people) responded in a way applicable for analysis. In total 321 men

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(64.6%), 174 women (35.0%) and 2 defined as other (0.4 %) completed the questionnaire with a mean age of $M = 34.44$ ($SD = 10.89$). The design of this study is a between-subjects correlational design.

Procedure

The research was conducted online in the form of a Dutch questionnaire. Participants were recruited through social media via LinkedIn, Facebook and Whatsapp and the Social and Behavioural Sciences research participation system.

Participants were asked to fill out a questionnaire regarding their preferences for bitter and sweet food, disgust sensitivity, beer experience, knowledge about beer, consumption of beer and bitter beer preferences, gender, date of birth and level of education. The link to the questionnaire was posted online with a social text where people were informed about the topic, the duration, the voluntary participation of the survey and that they could stop the survey at any time without any consequences.

One question of the sexual disgust subscale was accidentally not included in the questionnaire. The reliability of the sexual disgust subscale was calculated and Cronbach's Alpha was $\alpha = .76$. This is considered an acceptable reliability of the test. The original subgroup has a Cronbach's alpha of $\alpha = .87$. Therefore, analysis with this sexual disgust subgroup was still performed.

Measures

The questionnaire was made in qualtrics and measured the following variables:

Bitter Food Preferences. For the acceptance of bitterness in food a list of taste items, made by Meier, Moeller, Riemer-Peltz & Robinson, (2012) was included. The taste item list

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includes sweet, sour, bitter, salty and spicy food. The research for this thesis includes only two kinds of flavours, however: sweet and bitter... Four additional food products were added to the list, for the sweet items “poffertjes” and “stroopwafels” and the bitter additional items were Brussels sprouts and chicory. The sweet and bitter items were randomly presented and participants were asked to indicate to what extent they liked the different foods. An example for the sweet food is “honey”. An example for the bitter food is “coffee”. The items were measured on a 5-point Likert Scale that range from 1 (Not at all tasty) to 5 (Very tasty).

Bitterness Beer Preferences. Five questions were asked to measure the preferences of bitter beer. The first four questions were measured on a 5-point Likert Scale that range from totally disagree to totally agree. An example of one question is “Beer cannot be bitter enough for me”. The fifth question was about bitter beer in International Bitterness Units (IBU). Participants could indicate how bitter their ideal beer is moving the slider between 0 and 200.

Disgust Sensitivity. Disgust sensitivity of each participant will be measured with the 21-item Three-Domain Disgust Scale (Tybur, Lieberman, & Griskevicius, 2009). The three domains measure sensitivity to pathogen, sexual, and moral disgust. The pathogen domain, which consists of the avoidance of infectious microorganisms; a sexual domain, which consists of avoidance of costly sexual behaviors; and a moral domain, which consists of social avoidance of antisocial norm violators. The participants were asked how much disgust they feel for each item. An example of an item is “Sitting next to someone who has red sores on their arm.” or “Stealing from a neighbor”. The items were measured on a 7-point Likert Scale that range from 0 (Not at all disgusting) to 6 (Extremely disgusting).

Subjective Beer Knowledge. To measure the subjective knowledge of beer, the questionnaire from Johnson & Bastian (2007) was used. Their whole questionnaire measures the relationship between Australian wine consumers' wine expertise, their wine purchasing

and their consumption behaviour. In current study only the 5-item Subjective Wine Knowledge Scale was used. For the purpose of this research the word “wine” has been changed to “beer”, to measure the respondents subjective beer knowledge. An example of an question in present study is “I know a fair amount about beer.” The items were measured on a 9-point Likert Scale that range from 1 (Strongly disagree) to 9 (Strongly agree).

Beer Consumption. Two different questions were asked to measure the participants’ consumption of beer. The first question was “How many evenings a week do you drink beer?” answer categories went from “0” to “7”. The second question to answer beer consumption was “Average number of glasses of beer I drink in one evening:”, the seven answer categories went from “0” to “more than 16”.

Variation in Beer. To measure the participants’ variation in beer types two different questions were asked. The first one was “How many types (different brands, types, styles) of beer do you drink on average per week?”, with six different answer categories; “I always drink the same”, “2-3 types”, “4-5 types”, “6-7 types”, “I hardly ever drink the same thing” and “I don't drink beer”. The second question to measure a participants variation in beer was a statement: “When I drink beer, I prefer to drink:...”. Participants were able to choose from 9 different answer options for this question. Seven of these answers were different types of beer, which were grouped by IBU. The other two were “Otherwise, namely...”, here participants were able to fill out missed types of beer and “I don not drink beer”,

Demographics. Three different questions based on demographics were asked. The first question was to know the gender of the participant. The options were “Male”, “Female” and “Otherwise, namely:...” The second question was, the participants date of birth year “I was born in the year (Enter year "yyyy"):”. Participants could fill out there year of birth in a text

input. The last demographic question was “My highest completed or current education is:” with six different answer categories, which ranged from high school to PhD.

Data-Analysis

The *Statistical Package for the Social Science 25 (SPSS)* was used to analyse the data. The first step of the analyses were excluding invalid answers out of the data set. The first 12 rows of answers were excluded, these first answers were test trials for checking the survey.

Bitter Food Preferences. The variable bitter food was computed by adding all the bitter items and divided them by the total number of items that measure their bitter food preference. The same procedure was done for the sweet food preferences.

Bitter Beer Preferences. For the variable bitter beer preferences, the two answers "I think most beer is too bitter to be really tasty" and "I prefer to drink beer that is not bitter at all." were recode, this way all items run from not liking bitter beer to prefer bitter beer. After this the answers were normalized. The final step was creating the bitter beer preferences variable. This was done by adding up all the items and dividing this by the total number of questions.

Disgust sensitivity. For computing the three different subgroups of disgust, each subgroup score was added together and divided by the number of questions from that subgroup.

Subjective Beer Knowledge. To compute the variable Beer Knowledge, items two "I don't feel very knowledgeable about beer", four "I know less about beer compared to other people" and five "When it comes to beer, I don't really know much" were recode. This way, all items run from knowing very little about beer to knowing quite a lot about beer. The next

step was to calculate the variable by adding up all the scores and dividing this by the total of five items.

Beer consumption. Beer consumption was coded by adding the item “How many evenings a week do you drink beer?” to the item “Average number of glasses of beer I drink in one evening:”, and divided it by the total of two.

Variation in Beer. This question was to find out how many different beers a participant drinks on average. To compute this the first step done, was to manually count the "missed types of beer" and change this to an number. After this the seven answer categories from the question “When I drink beer, I prefer to drink” were added up to the "missed types of beer". This total amount was the variation in beer participants drink

Demographics. In order to compute the age of participants, the year of birth has been deducted from the current year. For the variable gender, each group, male, women, and other was dummy coded.

Analysis

All analyzes for this study were tested using *Statistical Program for Social Sciences (SPSS)* program. A total of three multiple regressions were performed. The first multiple regression was for checking the relationship between the dependent variable Bitter Food and the independent variable Age, Pathogen Disgust, Sexual Disgust, Moral Disgust, Beer Knowledge and Beer Consumption.

The second analysis was between the dependent variable Bitter Beer Preferences and the independent variables Age, Pathogen Disgust, Sexual Disgust, Moral Disgust, Beer Knowledge and Beer Consumption. After this, the last multiple regression was carried out for

Bitter Beer Preferences. It had approximately the same dependent and independent variables as before only the variable Beer Consumption was added to the independent variables.

Results

The goal of present study was to examine if there is a negative relationship between t bitterness acceptance and disgust sensitivity (hypothesis 1). And if this relations is dependent on experience(hypothesis 2), including gender and age.

Bitter Food Preferences.

The first multiple regression was to estimate the proportion of variance in bitter food preferences that can be accounted for moral disgust, sexual disgust, pathogen disgust, beer knowledge and age.

Prior to the results of the multiple regression analysis, several assumptions were evaluated. First, stem-and-leaf plots and boxplots indicated that each variable in the regression was normally distributed and free from univariate outliers. Second, inspection of the normal probability plot of standardised residuals as well as the scatter plot of standardised residuals against standardized predicted values indicated that the assumption is normally, linear and homoscedasticity of residuals were met. Third, Mahalanobis distance did not exceed the critical X^2 for $df = 7$ (at a $\alpha = .001$) of 24.32 for any case in the data file. Fourth, relatively high tolerance for all the predictors in the regression model indicating that multicollinearity would not interfere with our ability to interpret the outcome of the multiple regression.

In combination, moral disgust, sexual disgust, pathogen disgust, gender, age, beer knowledge and beer drinking experience accounted for a significant 7.3% of the variability in

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the liking of bitter food, Adjusted $R^2 = .061$, $F(7, 489) = 5.59$, $p \leq .001$, $f^2 = .06$.

Unstandardised (B) and standardised (β) regression coefficients, and squared semi-partial; (or 'part') correlations (sr^2) for each predictor in the regression model are reported in table 1.

Table 1

Unstandardised (B) and Standardised (β) Regression Coefficients, and Squared Semi-Partial (sr^2) For Each Predictor in a Regression Model Predicting the Preference of Bitter Food.

Variable	B [95% CI]	β	sr^2
Age	.013 [.008, .019]*	.233	.043
Disgust pathogen	-.045 [-.109, .020]	-.066	.003
Disgust sexual	-.037 [-.097, .023]	-.066	.002
Disgust moral	.050 [-.014, 0.113]	.073	.004
Beer Knowledge	.032 [.000, .063]*	.105	.008
Gender (Male)	-.144 [-.284, .012]	-.111	.007
Beer Consumption	-.059 [-.111, -.007]*	-.098	.010

Note $N = 497$. CI = Confidence Interval.

* indicates $p < .05$.

Bitter Beer Preferences

The second multiple regression was to estimate the proportion of variance in bitter beer preferences that can be accounted for moral disgust, sexual disgust, pathogen disgust, beer knowledge and age.

Prior to the results of the multiple regression analysis, several assumptions were evaluated. First, stem-and-leaf plots and boxplots indicated that each variable in the regression was normally distributed and free from univariate outliers. Second, inspection of

the normal probability plot of standardised residuals as well as the scatter plot of standardised residuals against standardized predicted values indicated that the assumption is normally, linear and homoscedasticity of residuals were met. Third, Mahalanobis distance did not exceed the critical X^2 for $df = 7$ (at a $\alpha = .001$) of 24.32 for any case in the data file. Fourth, relatively high tolerance for all the predictors in the regression model indicated that multicollinearity would not interfere with our ability to interpret the outcome of the multiple regression.

In combination, moral disgust, sexual disgust, pathogen disgust, age and beer drinking experience, beer knowledge and gender accounted for a significant 32.1% of the variability in the preferring of bitter beer, Adjusted $R^2 = .311$, $F(7, 481) = 32.49$, $p \leq .001$, $f^2 = .47$. This is considered a large effect. Unstandardised (B) and standardised (β) regression coefficients, and squared semi-partial; (or 'part') correlations (sr^2) for each predictor in the regression model are reported in table 2.

Results between the independent variables and the dependent variable Bitter beer were so interesting that another analysis with the variable different types of beers in the multiple regression was added. The assumptions for the multiple regression were similarly evaluated prior to the results.

First, the Stem-and-Leaf plots and boxplots indicated that each variable in the regression was normally distributed, and free from univariate outliers. Second, inspection of the normal probability plot of standardised residuals as well as the scatter plot of standardised residuals against standardized predicted values indicated that the assumption is normally, linear and homoscedasticity of residuals were met. Third, Mahalanobis distance did not exceed the critical X^2 for $df = 8$ (at a $\alpha = .001$) of 26.13 for any case in the data file, indicated that multivariate outliers were of no concern. Fourth, relatively high tolerance for all the

predictors in the regression model indicated that multicollinearity would not interfere with our ability to interpret the outcome of the multiple regression.

The multiple regression model accounted for a 32.7% variability of the linking of bitter beer., $R^2 = .327$, adjusted $R^2 = .316$, $F(8,488) = 29.13$, $p < .001$. The independent variables beer knowledge, gender and the variety of different beers were significant in relation to bitter beer preferences. Unstandardised (B) and standardised (β) regression coefficients, and squared semi-partial; (or ‘part’) correlations (sr^2) for each predictor in the regression model are reported in table 3

Table 2

Unstandardised (B) and Standardised (β) Regression Coefficients, and Squared Semi-Partial (sr^2) For Each Predictor in a Regression Model Predicting the Preference of Bitter Beer.

Variable	B [95% CI]	β	sr^2
Age	-.001[-.006, .005]	-.013	.001
Disgust pathogen	-.036 [-.099, .027]	-.047	.003
Disgust sexual	-.015[-.044, .074]	.023	.001
Disgust moral	-.013 [-.074, .049]	-.017	.001
Beer Knowledge	.156[.125, .187]*	.445	.170
Gender (Male)	.300[.155, .444]*	.205	.033
Beer Consumption	-.039 [-.091, .012]	-.058	.005

Note $N = 489$. *CI* = Confidence Interval.

* indicates $p < .05$.

Table 3

Unstandardised (B) and Standardised (β) Regression Coefficients, and Squared Semi-Partial (sr^2) For Each Predictor in a Regression Model Predicting the Preference of Bitter Beer.

Variable	B [95% CI]	β	sr^2
Disgust Pathogen	-.043 [-.106, .020]	-.056	.003
Disgust Sexual	-.018 [-.041, .077]	.028	.001
Disgust Moral	-.013 [-.074, .048]	-.017	.001
Beer Knowledge	.147 [.116, .179]*	.421	.116
Age	.001 [-.006, .005]	-.007	.001
Gender (Male)	.280 [.135, .425]*	.192	.029
Beer Consumption	-.032 [-.084, .019]	-.047	.003
Number of Different Beers	.035 [.001, .069]*	.083	.005

Note N = 489. CI = Confidence Interval.

** indicates $p < .05$.*

Discussion.

This study conducted a quantitative research to investigate whether there is a relationship between bitterness acceptance and disgust sensitivity and if this would be a negative relation. Different analyses were performed to measure the relation between bitter sensitivity and disgust sensitivity in combination with experience.

The first analysis found three different relations for bitter food. These were age, beer knowledge and beer consumption. The strongest relation was a negative relation between preference and bitter beer. The second relation was that between beer knowledge and its positive impact on preference for bitter food. The final relation of the first analyses shows age to have a positive impact on the acceptance of bitter food.

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The second analysis with bitter beer also revealed three relations. This was for gender, beer knowledge and the number of different beers a participant drinks. The strongest relationship here was between gender and bitter beer preferences. The second relation revealed that beer knowledge had a positive influence in the preference of bitter beer. The final relation of the analysis with bitter beer, shows that the number of different beers has a positive influence on the preferences of bitter beer.

The first hypotheses postulated that there is a negative relation between bitterness acceptance and disgust sensitivity". This study, however, did not find a relation between bitterness acceptance and disgust sensitivity in all of the multiple regression analysis. For this reason, hypotheses 1 was rejected.

These different results can be explained if we take into consideration that the nonexistent link that was found in the first hypothesis is the result of the combined research of Behrens et al. (2004), which explains the effect of bitterness as a warning system for taste receptors against ingestion of toxic substances. And the research of Tybur et al. (2009), which postulates that disgust plays a key role in motivating behaviour that cut down exposures to germs as well as the effects of disgust to increase general avoidance tendencies.

The relationship here would be, if the measured bitter foods would be seen as a toxic, disgust sensitivity would motivate someone to avoid or, at least, reduce the exposure to bitter foods, such as bitter beer. However, as previously stated, the research of Glendinning (1994) indicated that bitter is not a good predictor for toxicity. It seems that bitter foods, such as bitter beer, are not considered toxic and therefore disgust sensitivity is not a factor.

Another explanation that possibly accounts for the lack of a relation between preferences in bitter food and disgust sensitivity in this study is that disgust sensitivity is measured with the subscales moral, sexual and pathogen. And perhaps the relation between

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bitterness and disgust sensitivity for food is activated when food expires and therefore turns sour. So it may be if disgust is measured in aversion for sourness, the relationship will be present.

The second hypothesis holds that “experience with a bitter substitute has a positive relation with bitterness acceptance.” This relationship partly occurred in current study. To measure experience with bitter food three variables were measured; beer knowledge, beer consumption and drinking different types of beer. Beer knowledge had a positive influence for preferring bitter food and preferring bitter beer. There was a positive relationship between the number of different beers a person drinks and their preference for bitter food. However, consumption of beer did have a negative relation to the preference of bitter food, yet no relation to the preference for bitter beer.

These results partly conform to the theory postulated by Stein, et al. (2003). Their research investigated the effects of repeated exposure and health related information in hedonic evaluation and acceptance of a bittersweet beverage. And their research concluded that the acceptance of a bittersweet beverage improves after multiple days of drinking the beer in a setting they had chosen themselves. The part of the theory that is not in line with this study related to consumption. This study did not find the consumption of bitter beer to improve the preference for bitter foods. The part of the theory that does fit this research is the relation between having knowledge about the bitter substitute and preferring this bitter substitute despite it not being health related. In other words, the bitter substitute was preferred for other reasons than health and toxicity.

Interesting results were for bitter beer preference in relation to beer consumption, beer knowledge and number of different beers. Beer consumption had in this study no relation with bitter beer preferences. However, between beer knowledge and number of different beers had

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a positive relation with bitter beer preferences. This combination of relations, may imply that openness plays a role in the preference of bitter beer. On that account, it is possible that having more knowledge and drinking a greater variety of bitter beer types, increases the bitter beer preferences and reduces the disgust sensitivity. This would explain why this study did not find a relationship between bitterness preferences and disgust sensitivity.

Limitations.

Although this study provided relevant insight, it has several limitations. First, in this study only self reported measures were used. This can have an impact on the validity of the study. It is possible that participants are ashamed of their drinking behaviour and therefore provide incorrect data. It is also possible for participants to inadvertently give wrong answers due to having inadequate introspective abilities. In order to garner more factual data a solution would be to have people note their drinking behavior over a month.

Another limitation is that “bitterness in beer” is a difficult concept. This is because bitterness in beer is easily influenced by the amount of sugar added, therefore not all mentioned IBU in a beer has the same bitterness. As a result, people may assume they have a preference a for a certain bitterness that they actually do not. A way of solving this problem would be, to conduct the research in a laboratory where participants are served several glasses of the same beer, but with different in amount of bitterness. This would enable researchers to measure bitterness preferences more accurately.

Further Research.

Further research should take into account that openness may play a role in the relation between bitterness preference and disgust sensitivity. Hence, if more research is done between

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the relationship of bitterness and disgust, future research can benefit from taking openness into account and to what extent this impacts the results. This can be done by taking a sample of beer drinkers who are either drinking one kind of beer or drinking more different kinds of beer.

A final recommendation is to measure the bitterness acceptance in a laboratory, so that socially desirable answers disappear and the research has more validity.

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Appendix

Informed Consent

Q11 Beste deelnemer, Bedankt dat u heeft gekozen om deel te nemen aan dit onderzoek. Dit onderzoek is onderdeel van de Masteropleiding Sociale, Gezondheids- en Organisationspsychologie aan de Universiteit Utrecht. Het doel van dit onderzoek is om inzicht te krijgen in de relatie tussen bier en walgingsgevoeligheid. Het invullen van de vragenlijst duurt ongeveer 10 minuten. Vrijwillige deelname Door het invullen van deze enquête geeft u akkoord om gebruik te maken van de ingevulde gegevens. Als u zich om welke reden dan ook ongemakkelijk voelt bij het beantwoorden van de vragen, kunt u op elk moment zonder gevolgen stoppen door het scherm te sluiten. Anonieme gegevensverwerking. Er zijn enkele gegevens van u nodig, deze zullen anoniem verwerkt worden. En deze zijn daardoor niet meer terug te herleiden naar u. Ze zullen alleen gebruikt worden voor wetenschappelijke doeleinden, en wanneer de gegevens gedeeld worden gebeurt dat in anonieme vorm, dus niet herleidbaar naar u. Gegevensopslag. Uw gegevens worden (geanonimiseerd) bewaard op een beveiligde server. Dit is conform de richtlijnen van de VSNU Vereniging van Universiteiten in Nederland. Voor meer informatie over privacy wil ik u verwijzen naar de website van de Autoriteit Persoonsgegevens:

<https://autoriteitpersoonsgegevens.nl/nl/onderwerpen/avg-europese-privacywetgeving> Vragen en klachten Voor vragen over dit onderzoek kunt u contact met mij (j.m.derksen@students.uu.nl) of mijn begeleider (i.m.croijmans@uu.nl) opnemen. Door hieronder op "ja, ik wil deelnemen aan het onderzoek" te klikken en verder te gaan en naar de volgende pagina, verklaart u dat u de informatie over dit onderzoek heeft gelezen en begrepen, en dat u hiermee akkoord bent. Als u niet wilt deelnemen kunt u het venster nu sluiten.

Ja, ik wil deelnemen aan dit onderzoek (1)

Q1 Hieronder staan verschillende etenswaren. Kunt u aangeven in welke mate u deze etenswaren lekker vindt, waarbij een 1 = "Helemaal niet lekker", 5 = "Heel lekker"?

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Snoepjes (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Caramel (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chocolade cake (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Honing (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maple syrup (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
IJs (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peer (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aarbeien (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Suiker (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stroopwafels (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poffertjes (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bitter lemon (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kool (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Koffie (14)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cottage Cheese (15)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grapefruit (16)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Radijsjes (17)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Roggebrood (18)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thee (19)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tonic Water (20)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spruitjes (21)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Witlof (22)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Q22 De volgende zinnen beschrijven een aantal situaties. Kunt u alstublieft aangeven hoeveel walging u voelt bij de volgende zinnen, waarbij 0 = "Helemaal niet walgelijk" , 6 = "Extreem walgelijk ".

	0	1	2	3	4	5	6
Snoep stelen uit de buurtwinkel (1)	0	0	0	0	0	0	0
Twee vreemden horen die seks hebben (2)	0	0	0	0	0	0	0
In de hondenpoep trappen (3)	0	0	0	0	0	0	0
Stelen van een buurman (4)	0	0	0	0	0	0	0
Orale seks op iemand bedrijven (5)	0	0	0	0	0	0	0
Naast iemand zitten met rode zweren op zijn/haar arm (6)	0	0	0	0	0	0	0
Een student die bedrog pleegt om goede cijfers te halen (7)	0	0	0	0	0	0	0
Een pornografische video kijken (8)	0	0	0	0	0	0	0
De hand schudden van iemand met zweethanden (9)	0	0	0	0	0	0	0
Een vriend oplichten (10)	0	0	0	0	0	0	0
Schimmel ontdekken op een paar oude restjes in je koelkast (11)	0	0	0	0	0	0	0
Iemands handtekening vervalsen op een officieel document (12)	0	0	0	0	0	0	0
Iemand die je net hebt ontmoet mee naar je kamer nemen om seks te hebben (13)	0	0	0	0	0	0	0
Dicht bij iemand staan die stinkt (14)	0	0	0	0	0	0	0
Voordringen om de laatste kaartjes voor een voorstelling te bemachtigen (15)	0	0	0	0	0	0	0
Een vreemde van het andere geslacht die in de lift opzettelijk tegen je dijbeen aanschurkt (16)	0	0	0	0	0	0	0
Een kakkerlak over de vloer zien rondscharrelen (17)	0	0	0	0	0	0	0
Met opzet liegen bij een zakelijke transactie (18)	0	0	0	0	0	0	0
Anale seks hebben met iemand van het andere geslacht (19)	0	0	0	0	0	0	0
Per ongeluk iemands open wond aanraken (20)	0	0	0	0	0	0	0

Q24 Lust u bier?

- Nee, ik drink het ook nooit (1)
- Jawel, maar ik drink het (vrijwel) nooit (2)
- Jawel (3)

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Q10 De volgende vragen gaan over uw bierkennis. Beoordeelt u alstublieft in hoeverre de volgende stellingen op u van toepassing zijn, op een schaal van 1 tot 9 met de volgende betekenis: 1 = "Sterk mee oneens", 5 = "Niet mee eens of Mee oneens", en 9 = "Sterk mee eens".

	1	2	3	4	5	6	7	8	9
Ik weet behoorlijk veel van bier (1)	o	o	o	o	o	o	o	o	o
Ik voel me niet heel erg deskundig op het gebied van bier (2)	o	o	o	o	o	o	o	o	o
In mijn vriendengroep ben ik één van de 'experts' op het gebied van bier (3)	o	o	o	o	o	o	o	o	o
Vergeleken met andere mensen weet ik minder van bier (4)	o	o	o	o	o	o	o	o	o
Als het op bier aankomt weet ik eigenlijk niet zo veel (5)	o	o	o	o	o	o	o	o	o

Q12 De volgende vragen gaan over hoeveel en wat voor bier u in een gemiddelde week consumeert.

Q23 Hoeveel avonden per week drinkt u bier?

▼ 0 avonden per week. (1) ... (vrijwel) elke avond (8)

Q24 Gemiddeld aantal glazen bier dat ik op een avond drink:

- 0 (8)
- 1 - 3 (1)
- 4 - 5 (2)
- 6 - 8 (3)
- 9 - 11 (4)
- 12 - 14 (5)
- 15 - 16 (6)
- meer dan 16 (7)

Q19 Hoeveel soorten (verschillende merken, soorten, stijlen) bier drinkt u gemiddeld per week?

- Ik drink altijd hetzelfde (1)
- 2-3 soorten (2)
- 4-5 soorten (3)
- 6-7 soorten (4)
- Ik drink vrijwel nooit hetzelfde (5)
- Ik drink geen bier (6)

Q26 Ik ben begonnen met het drinken van bier in het jaar ("yyyy"):

Q27 Als ik bier drink, drink ik het liefst: (meerdere antwoorden mogelijk)

- Pils/lager (1)
- Fruitbier / Kriek / Geu(e)ze of (internationale) sours (2)
- Wit bier (3)
- Blond / Bruin / Amber (4)
- Tripel / Dubbel / Quadrupel (5)
- Pale ale / IPA of varianten daarop (IPA/DIPA/TIPA/NEIPA etc) (6)
- Stout (inclusief porter, stout, RIS en BA) (7)
- Anders, namelijk (9) _____
- Ik drink nooit bier/NVT (10)

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Q23 Nu volgen nog enkele vragen over bier.

Q13 In hoeverre bent u het eens met de volgende stelling:

- "Bier kan mij eigenlijk niet bitter genoeg zijn"
- Helemaal mee oneens (1)
 - Mee oneens (2)
 - Niet mee oneens, niet mee eens (3)
 - Mee eens (4)
 - Helemaal mee eens (5)

Q20 In hoeverre bent u het eens met de volgende stelling:

- "Bier hoort bitter te zijn"
- Helemaal mee oneens (1)
 - Mee oneens (2)
 - Niet mee oneens, niet mee eens (3)
 - Mee eens (4)
 - Helemaal mee eens (5)

Q21 In hoeverre bent u het eens met de volgende stelling:

- "Het meeste bier vind ik eigenlijk te bitter om echt lekker te zijn"
- Helemaal mee oneens (1)
 - Mee oneens (2)
 - Niet mee oneens, niet mee eens (3)
 - Mee eens (4)
 - Helemaal mee eens (5)

Q22 In hoeverre bent u het eens met de volgende stelling:

- "Het liefst drink ik bier wat helemaal niet bitter is."
- Helemaal mee oneens (1)
 - Mee oneens (2)
 - Niet mee oneens, niet mee eens (3)
 - Mee eens (4)
 - Helemaal mee eens (5)

Q14 Bitterheid in bier wordt zoals u mogelijk weet gemeten in International Bitterness Units ("IBU"). De meeste witbieren en fruitbieren hebben een lage bitterheid, met minder dan 15 IBU, pilsener is gemiddeld bitter met 20-40 IBU, terwijl bittere bierstijlen zoals IPA of stout een bitterheid hebben van 50-70 IBU. Sommige bieren zijn nog bitterder. Kunt u hieronder aangeven hoe bitter, in IBU, uw ideale biertje zou zijn? Indien u nooit bier drinkt kunt u antwoorden met '0 IBU'.

0 20 40 60 80 100 120 140 160 180 200 IBU ()

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Q18 Beantwoord alstublieft nu nog de volgende vragen:

Q28 Ik ben:

- Man (1)
- Vrouw (2)
- Anders, namelijk: (3) _____
- Zeg ik liever niet (4)

Q29 Ik ben geboren in het jaar (Jaartal invullen "yyyy"):

Q30 Mijn hoogste behaalde of huidige opleiding is:

- Middelbare School (1)
- MBO (2)
- Bachelor - HBO (3)
- Bachelor - WO (4)
- Master - WO (5)
- Phd (6)

Q17 Dit is het einde van het onderzoek, hartelijk dank voor uw deelname! Als u op het pijltje hieronder klikt wordt u doorgeleid naar een nieuwe pagina waar u uw e-mailadres kunt achterlaten om deel te nemen aan de verloting van 3 cadeaubonnen van €25. Mocht u nog vragen hebben dan kunt u contact opnemen met Janneke Derksen (j.m.derksen@studetns.uu.nl), of Ilya Croijmans, (i.m.croijmans@uu.nl).