Affective touch: A meta-analysis on perceived pleasantness in healthy adults

Master thesis Neuropsychology

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Abstract

Interpersonal touch plays an important role in human life and has physical and mental health benefits during development and adulthood. A specific type of interpersonal touch that is experienced as pleasant is affective touch (AT), which is characterized by slow stroking. On the contrary, non-affective touch (non-AT) is perceived as less pleasant than AT and is characterized by fast stroking. In the current study, meta-analyses were performed with the aim of quantifying the difference in perceived pleasantness between AT and non-AT in healthy adults. In addition, several moderators were identified to assess what factors would influence the perceived pleasantness of AT. Results showed that AT is perceived as more pleasant than non-AT. Moreover, mean pleasantness ratings were calculated for both AT and non-AT, which can be used in future research to make comparisons. These mean pleasantness ratings are baseline ratings of pleasantness, as no studies were included that assessed the pleasantness of (non-)AT during the performance of a task. More importantly, these baseline ratings can be considered as a baseline on how people perceived (non-)AT before the COVID-19 pandemic, which gives some interesting starting points for future research. Finally, the current study gave insight into methodological aspects that could influence the perceived pleasantness of AT. Even though some limitations have to be taken into account when interpreting the results of the current study, it contributed to a broader knowledge on the perception of AT.

Key words: affective touch, non-affective touch, ct afferents, pleasantness, meta-analysis

Introduction

Interpersonal touch plays an important role in human life. From being a fetus in the womb and being a new-born who is being cuddled and breastfed, till being an adult and having relationships, we all experience interpersonal touch in our lives. Touch is the largest of our sense organs and it is the first one to develop (Field, 2010). It is also our most social sense and central to the shaping and maintenance of our relationships (Russo et al., 2020). We use it to share our feelings with others as well as to strengthen the meaning of other forms of (non-)verbal communication (Gallace & Spence, 2010). Indeed, Jones & Yarbrough (1985) consider interpersonal touch as more powerful than language, because it is more vital and direct. Also, interpersonal touch has physical and mental health benefits during development and adulthood (Gentsch et al., 2015). For example, children who receive frequent touch during childhood are more likely to develop a secure attachment style (Jakubiak & Feeney, 2016), which is related to a better quality of life (Bodner & Cohen-Fridel, 2010). According to Morrison (2016b), another role of interpersonal touch is that it can act as a buffer for stress. Moreover, tactile stimulation has an important role in the development of a healthy social brain (Cascio et al., 2019). Conversely, a lack of interpersonal touch during development could have negative consequences (Gallace & Spence, 2010), such as producing long lasting damages to the brain like a reduction of gray matter or lower quality of brain activation (Nelson, 2014). Evidently, the experience of touch is necessary for development and leads to sensations of both sensory and emotional aspects (Ackerley et al., 2014b). A lot of research has focused on the effects of interpersonal touch, but also on how pleasant people find it to be touched. The aim of the current study was to give more insight into the hedonic aspects of interpersonal touch through meta-analysis.

A specific type of interpersonal touch that is experienced as a pleasant form of touch is affective touch (AT) (Löken et al., 2009). Morrison (2016a) defined this type of touch as tactile processing with a hedonic or emotional component. AT has been linked to C-tactile (CT) afferents, which are slow-conducting, unmyelinated nerves present in the hairy, but not in the glabrous skin of mammals, including humans (Löken et al., 2009; Olausson et al., 2010). CT afferents show preferential response rates to stimulation delivered at human skin-like temperatures (Ackerley et al., 2014b), with caress-like velocities (Russo et al., 2020) ranging from 1 – 10 cm/s. Importantly, the firing frequencies of these afferents show correlations with pleasantness ratings during caress stimulation (Löken et al., 2009). This slow and gentle type of touching is likely present in affiliative interactions between individuals, such as between a parent and a child, between siblings or between loved ones (Olausson et al., 2010). Evidently, the most promising functional role of the CT system has first been described by Vallbo et al. (1999) as the social or affective touch hypothesis. According to this hypothesis, the role of the CT system is to boost the emotional effects of being close to a friendly person (McGlone et al., 2007), as well as to support feelings of reward, confidence, comfort and security. Moreover, it may have a role in bonding individuals emotionally together and in hormonal responses (Vallbo et al., 2016). Overall, AT refers to an emotional reaction to tactile stimulation, in particular the pleasantness of such contact (Essick et al., 2010).

While AT is experienced as pleasant, non-affective touch (non-AT) is generally perceived as more neutral (Löken et al., 2009). Indeed, several studies concluded that AT is experienced as more pleasant than non-AT (e.g., Pawling et al., 2017; Sehlstedt et al., 2016). There are several other factors that distinguish AT from non-AT. First, whereas AT is coded by slow-conducting, thin and unmyelinated fibres (Löken et al., 2009; Olausson et al., 2010), non-AT is coded by fast-conducting, thick and myelinated fibres, known as Aβ afferents (McGlone et al., 2014; Morrison et al., 2011). These fibres show preferential response rates to stimulation with faster stroking velocities, ranging from 18 – 30 cm/s (Löken et al., 2009) and convey the discriminative properties of touch, such as vibration, pressure and texture (Cascio et al., 2019; McGlone et al., 2007; McGlone et al., 2014). A further distinction between AT and non-AT can be made based on the brain regions their afferents project to. CT afferents follow a distinct pathway to the posterior insula (Craig, 2002; Olausson et al., 2002) and also, gentle touch activates the posterior insula (Morrison, 2016a; Morrison et al., 2011; Olausson et al., 2002). The insula is thought to be important for emotional experiences (Singer et al., 2009), self-awareness (Baier & Karnath, 2008) as well as homeostatic balance (Craig, 2009). On the other hand, myelinated fibres that convey non-AT project to the primary somatosensory cortex (Morrison, 2016a; Olausson et al., 2002). However, secondary somatosensory cortices both show activation for AT as well as for discriminative, non-AT (Morrison, 2016a). Thus AT and non-AT seem not only to be distinguishable based on the tactile properties they inform us about, but also based on the brain regions they project to and activate.

Despite the fact that multiple studies already concluded that AT is experienced as more pleasant than non-AT (e.g., Pawling et al., 2017; Sehlstedt et al., 2016), this had never been investigated through a meta-analysis. Currently, only one meta-analysis exists that investigated perceived pleasantness of AT (Russo et al., 2020). However, Russo et al. (2020) investigated differences in perceived pleasantness of AT between men and women and did not examine differences in perceived pleasantness between AT and non-AT. To contribute to filling this gap, the current study performed meta-analyses with the aim of quantifying the difference in perceived pleasantness between AT and non-AT in healthy adults. First, it was investigated whether AT is perceived as more pleasant than non-AT. Based on the above described evidence of the distinction between AT and non-AT and based on previous research that concluded that AT is perceived as being more pleasant than non-AT, it was expected that AT is perceived as more pleasant than non-AT. Secondly, mean pleasantness ratings were calculated for both AT and non-AT.

Moreover, there is still little empirical evidence of methodological aspects of a study that could influence the perceived pleasantness of AT. Even though Russo et al. (2020) looked at moderator variables in their meta-analysis, they assessed the influence of moderators on the sex difference in the perception of AT and did not assess the influence of moderators on the perception of AT. Currently, for example, it is known that women experience AT as more pleasant than men (Russo et al., 2020) and that older people experience AT as more pleasant than younger people (Sehlstedt et al., 2016). Also, pleasantness ratings are found to be sensitive to visual social cues (Willemse et al., 2016), such as the gender of the person that is touching the other person (Gazzola et al., 2012). However, there are several other factors that could influence the perceived pleasantness of AT, such as the material used to apply the touch, the location of the touch or the way participants needed to rate the touch. Therefore, the present study identified several moderator variables with the aim of investigating which factors would influence the perceived pleasantness of AT.

The current study was able to add something to the existing literature on the perception of (non-)AT, as it provided insight into the difference in perceived pleasantness of AT and non-AT while only including studies in the meta-analyses that assessed the pleasantness of the touch without simultaneously performing a task. Moreover, the mean baseline pleasantness ratings that were calculated for both AT and non-AT could also be considered as a baseline measure of the perception of pleasantness of (non-)AT before the COVID-19 pandemic. In other words, the studies included in the meta-analyses were performed before the COVID-19 pandemic and as touch will probably never be experienced the same as before this pandemic, this mean rating of pleasantness might be useful for researchers. Overall, this study provided a more general conclusion on the perception of pleasantness of (non-)AT based on baseline measures and it thus helped to gain a better understanding on this topic.

Methods

Search strategy

PubMED and PsycINFO were searched on October 19th 2020 for articles written between 2015 and 2020. The following keywords were used: affective touch OR pleasant touch OR gentle touch OR ct optimal touch OR slow touch.

Selection criteria

The following inclusion criteria were applied: (1) the study contains a pleasantness rating of affective touch (AT) and/ or non-affective touch (non-AT) and this measure is a baseline measure, thus not during for instance the performance of a task, (2) the velocity of the AT is between 1 – 10 cm/s, (3) the location where the touch is applied is a region where CT-fibres are present. If the study also included non-affective touch, the following inclusion criterium was applied: (4) the velocity of the non-AT is between 18 – 30 cm/s.

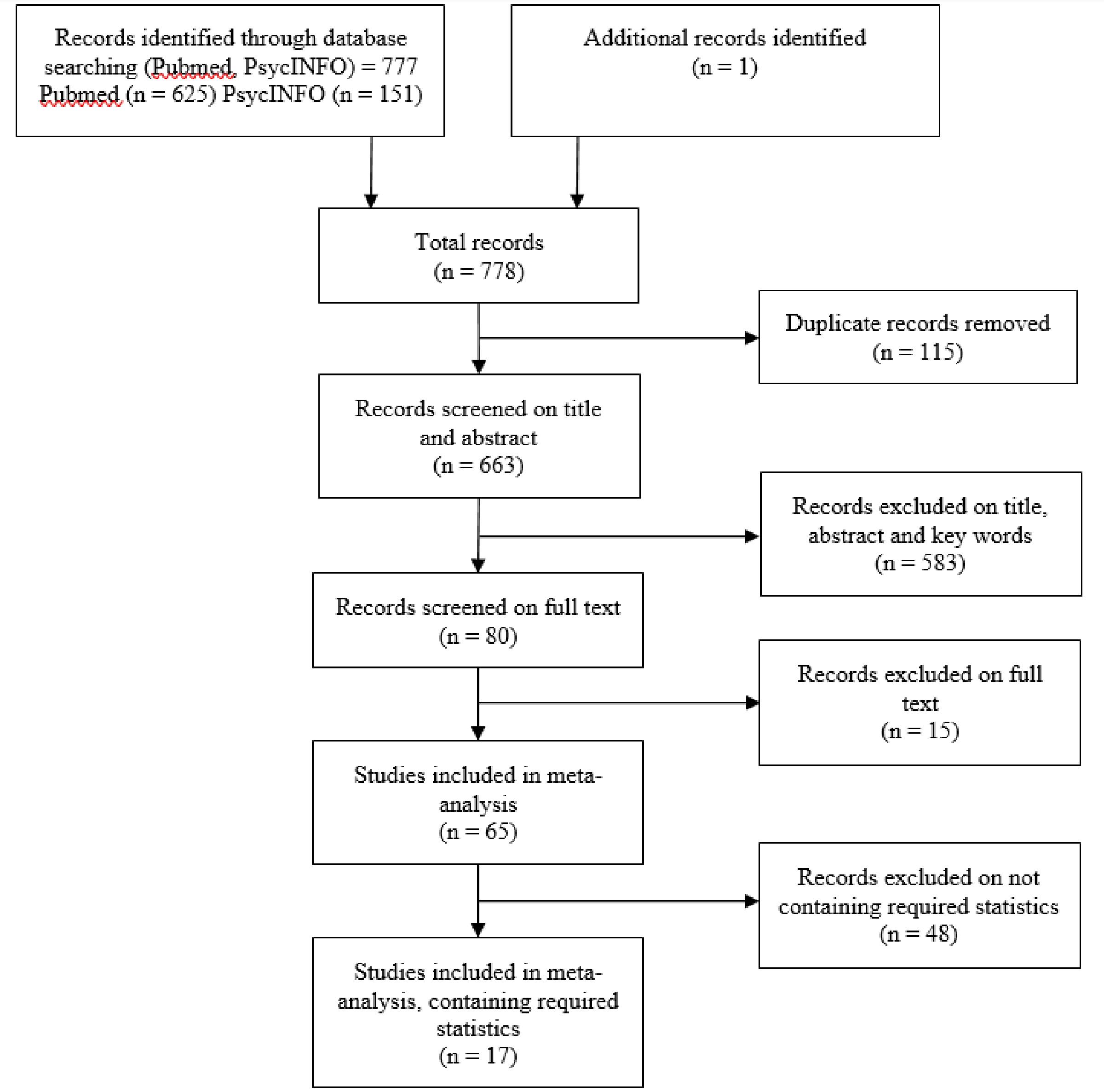
The following exclusion criteria were applied: (1) the study is a meta-analysis or a review, (2) the study included children, (3) the study included animals, (4) the study was a case study and (5) the study did not include a control group when investigating a (non-)clinical population.

Study selection

A total of 778 studies were found. All articles were uploaded in the online program Rayyan (Ouzzani et al., 2016), where duplicate studies were removed and articles were screened on their titles, abstracts and key words. After excluding duplicates, 663 studies were left to be screened. 583 studies were excluded based on their title, abstract and/ or key words, because the topics of these studies were clearly not about (non)-AT or because the inclusion- and/ or exclusion criteria were (not) met. Eighty studies were left to screen on full texts and 15 more studies were excluded. This resulted in a total of 65 included studies. In order to perform the meta-analyses, the sample size, the mean rating of pleasantness of the (non-)AT and its standard deviation were needed. Among the 65 included studies, 17 studies provided these statistics. Finally, 17 articles provided information about the perceived pleasantness of AT and 10 articles provided information about the perceived pleasantness of non-AT. See Figure 1 for an overview of the study selection and Table 1 and Table 2 for all included studies.

Figure 1

Flow diagram of study selection for the meta-analysis.



Coding of study characteristics and moderators

The included studies were analysed on study characteristics and moderator variables. General study information (e.g. authors, publication year), sample characteristics (e.g. sample size, age, gender), pleasantness ratings (mean rating of pleasantness, standard deviation or standard error, used scale) and information on moderator variables were coded for each study.

Moderators were grouped into three categories: participant characteristics, stimulation characteristics and answer characteristics. According to Van Alten et al. (2019), this approach is considered to be the best balance between the risk of type 1 errors (univariate moderator analysis) and type 2 errors (all variables in one model). All studies included in the meta-analysis, including moderator variables are shown in Table 1.

Participant characteristics

The following moderator variables were selected as participant characteristics: sex distribution (percentage of women) and mean age (years).

Stimulation characteristics

The following stimulation characteristics were selected as stimulation characteristics: the velocity of the touch (cm/s), the location of the touch (5 levels: forearm, thigh, hand, infraorbital region or forearm and shin), the stimulation type (3 levels: brush, fleece or fingertips) and the administrator (2 levels: robotic device or experimenter).

Answer characteristics

The following stimulation characteristics were selected as answer characteristics: answer, meaning the way which participants needed to rate the pleasantness of the touch given (3 levels: unknown, written or verbally) and questions, meaning the number of questions that assessed pleasantness (2 levels: one or more).

Table 1

Included studies for meta-analyses and moderator variables

	Participant characteristics		**Stimulation characteristics**				**Answer characteristics**	
Study	**Mean Age**	**Sex distribution**	**Velocity touch**	**Location**	**Stimulation type**	**Administrator**	**Answer**	**Questions**
Bershad et al. 2019	24.80	50.00	3.00	Forearm	Brush	Experimenter	Unknown	One
Bischoff-Grethe et al. 2018	26.30	100.00	2.00	Forearm	Brush	Experimenter	Written	One
Boehme et al. 2020	42.70	100.00	3.00	Forearm	Brush	Experimenter	Written	One
Chen et al. 2020	21.19	0.00	8.00	Forearm	Brush	Experimenter	Unknown	One
Crucianelli et al. 2018	22.07	100.00	3.00	Forearm	Brush	Experimenter	Verbally	One
Davidovic et al. 2016	25.00	52.17	2.00	Thigh	Brush	Experimenter	Written	One
Davidovic et al. 2018	21.20	100.00	2.00	Forearm	Brush	Robotic device	Verbally	One
Kass-Iliyya et al. 2017	63.60	59.26	3.00	Forearm	Brush	Experimenter	Written	One
Keizer et al. 2019	22.13	95.65	3.00	Forearm	Brush	Experimenter	Written	Multiple
Keizer & Montagne, under review	22.53	100.00	3.00	Hand	Brush	Experimenter	Written	Multiple
Kirsch et al. 2014	32.27	57.35	3.00	Forearm	Fingertips	Experimenter	Written	One
Krahé et al. 2016	23.76	100.00	3.00	Forearm	Brush	Experimenter	Unknown	One
Liljencrantz et al. 2017	23.00	50.00	3.00	Forearm and shins	Brush	Experimenter	Written	One
Ogden et al. 2015	23.90	100.00	3.00	Forearm	Fleece	Robotic device	Written	One
Ree et al. 2019	24.90	61.36	3.00	Forearm	Brush	Experimenter	Written	One
Taneja et al. 2019	25.80	100.00	3.00	Infraorbital	Brush	Experimenter	Written	One
Von Mohr et al. 2017	22.54	100.00	3.00	Forearm	Brush	Experimenter	Unknown	One

Data manipulation

In order to perform a meta-analysis and compare these studies, the mean rating of pleasantness of the touch and its standard deviation should be on the same scale. Because every study used another scale to assess the perceived pleasantness of (non-)AT, these mean ratings and their standard deviations were not on the same scale. For instance, some studies used a scale from 0 (unpleasant) – 10 (pleasant) and some studies used a scale from -5 (unpleasant) – 5 (pleasant). Every scale was converted to the scale 0 (unpleasant) – 100 (pleasant). See Appendix A for a detailed overview on which formulas were used to convert the scales. All studies included in the meta-analyses, including their sample size and mean pleasantness ratings for AT and non-AT, are shown in Table 2.

The scale that was used to assess the pleasantness of the touch might have influenced the outcome. According to Bolognese et al. (2003), a VAS scale might have better precision and is more sensitive than a Likert scale. However, Jensen et al. (1986) found similar responses on VAS scales (0 – 100 and 0 – 10) and Likert scales (4-, 5- and 6-point). To make sure that the studies did not differ in outcomes due to the scale they used, a one-way ANOVA was performed in RStudio (See Appendix B) to test whether the mean pleasantness ratings were influenced by the scale that was used. The ANOVA was not significant, indicating that the mean pleasantness ratings were not influenced by the scale used to assess the perceived pleasantness of (non-)AT, F (6, 10) = 1.237, p = 0.365.

Table 2

Studies included in the meta-analyses and statistics used to derive effect sizes

			Mean pleasantness ratings AT		**Mean pleasantness ratings non-AT**	
Study	***N***	**Scale (unpleasant – pleasant)**	**Raw *M* AT (*SD*)**	**Converted *M* AT (*SD*)**	**Raw *M* non-AT (*SD*)**	**Converted *M* non-AT (*SD*)**
Bershad et al. 2019	36	1 – 7	4.83 (1.03)	62.56 (16.82)	3.98 (1.00)	48.67 (16.33)
Bischoff-Grethe et al. 2018	26	0 – 100	48.90 (26.60)	48.90 (26.60)		
Boehme et al. 2020	29	-10 – 10	8.20 (1.90)	91.00 (9.50)	7.20 (3.00)	86.00 (15.00)
Chen et al. 2020	12	-4 – 4	2.46 (0.62)	80.75 (7.75)		
Crucianelli et al. 2018	76	0 – 100	62.64 (20.49)	62.64 (20.49)	47.96 (20.49)	47.96 (20.49)
Davidovic et al. 2016	25	-5 – 5	1.50 (1.60)	65.00 (16.00)		
Davidovic et al. 2018	23	-5 – 5	1.90 (1.10)	69.00 (11.00)		
Kass-Iliyya et al. 2017	27	-100 – 100	55.00 (20.78)	77.50 (10.39)	41.20 (11.95)	70.60 (11.95)
Keizer et al. 2019	30	0 – 10	6.88 (1.66)	68.78 (16.65)	5.70 (2.15)	56.95 (21.47)
Keizer & Montagne, under review	23	0 – 100	70.28 (23.38)	70.28 (23.38)	38.25 (25.37)	38.25 (25.37)
Kirsch et al. 2014	68	1 – 10	6.95 (1.56)	66.11 (17.33)	5.04 (1.67)	44.89 (18.56)
Krahé et al. 2016	24	-5 – 5	2.66 (1.65)	76.60 (16.50)	1.90 (1.53)	69.00 (15.30)
Liljencrantz et al. 2017	22	0 – 10	5.80 (0.94)	58.00 (9.38)	4.30 (1.41)	43.00 (14.07)
Ogden et al. 2015	20	-5 – 5	3.62 (1.12)	86.20 (11.20)		
Ree et al. 2019	44	-10 – 10	4.60 (4.20)	73.00 (21.00)		
Taneja et al. 2019	20	0 – 100	39.00 (5.80)	39.00 (5.80)		
Von Mohr et al. 2017	42	0 – 100	67.68 (16.22)	67.68 (16.22)	51.07 (13.45)	51.07 (13.45)

Data analysis

All analyses were performed in RStudio, using the metafor package (Viechtbauer, 2010). The metafor package is one of the most downloaded R packages and it is very flexible for researchers interested in conducting a meta-analysis (Polanin et al., 2017). For all codes used in RStudio, see Appendix B. In total, three meta-analyses were conducted. Random-effects models were used for all three meta-analyses, as a random-effects model allows effect sizes to vary across studies (DerSimonian & Laird, 1986). Also, consistent with this, the assumption that there is one general effect size that is true for all studies could not be presumed (Borenstein et al., 2009).

Meta-analysis difference in pleasantness AT and non-AT

The first meta-analysis was performed to see whether the mean ratings of pleasantness of AT and non-AT differed from each other when all studies were combined. A meta-analysis for two-group comparisons was conducted, with standardized mean difference as measure argument. For each study, Hedge's g (effect size) was calculated using the escalc function with as inputs the mean ratings of pleasantness of AT (m1i) and non-AT (m2i), their standard deviations (sd1i, sd2i) and the sample sizes (n1i, n2i) (Viechtbauer, 2010). According to Cohen (1988), effect sizes equal to .20, .50 and .80 are respectively considered small, medium and large. A positive effect size indicates that AT is perceived as more pleasant than non-AT.

Meta-analyses pleasantness AT and non-AT

Furthermore, two meta-analyses were performed to calculate mean ratings of pleasantness of AT and non-AT when all studies were combined. Meta-analyses for individual groups were conducted and for each study, effect sizes were calculated using the escalc function with as inputs the mean rating of pleasantness of AT or non-AT (mi), its standard deviation (sdi) and the sample size (ni) (Viechtbauer, 2010).

Heterogeneity

For each meta-analysis, Cochran's Q-test and I^2 statistics were reported to assess heterogeneity. Q is the weighted sum of squared differences between the observed effects and the weighted average effect. A significant Q value indicates that heterogeneity is present (Hak et al., 2016). I^2 describes the proportion of total variation in study estimates that is due to heterogeneity (Higgins & Thompson, 2002) and is presented as a percentage. 25%, 50% and 75% respectively indicate small, moderate and high levels of heterogeneity (Borenstein et al., 2017). Also for each meta-analysis, potential outliers and influential cases were checked. If there was an influential case, the results of one-study-removed analyses were given to show what the results would have been if the most influential case was not included in the meta-analysis (Viechtbauer, 2010).

Publication bias

To reduce the effect of publication bias, one unpublished study (Keizer & Montagne, under review) was included in all three meta-analyses. In addition, to inspect publication bias, funnel plots were constructed for all meta-analyses using the metafor package (Viechtbauer, 2010). In the absence of publication bias, one would expect to see the points forming a funnel shape (Sterne & Egger, 2001). However, when a funnel plot shows signs of asymmetry, this could indicate publication bias (Egger et al., 1997). Furthermore, a rank correlation test, which calculates Kendall's tau (Begg & Mazumdar, 1994), and Egger's regression test (Egger et al., 1997) were conducted using the metafor package (Viechtbauer, 2010). Both tests show proof for publication bias when they are significant (Begg & Mazumdar, 1994; Egger et al., 1997).

Moderator analyses

Moderator analyses were performed to assess whether certain factors would influence the mean rating of pleasantness of AT. Mixed-effects meta-regressions, which allow for between-study variation (Van Alten et al., 2019), were conducted for all three categories of moderator variables. All moderator analyses were performed in RStudio, using the metafor package (Viechtbauer, 2010). The Knapp and Hartung adjustment method to the standard errors of the estimated coefficients was used to account for the uncertainty in the estimate of residual heterogeneity (Knapp & Hartung, 2003). Moreover, this method will lead to more conservative p-values (Viechtbauer, 2010).

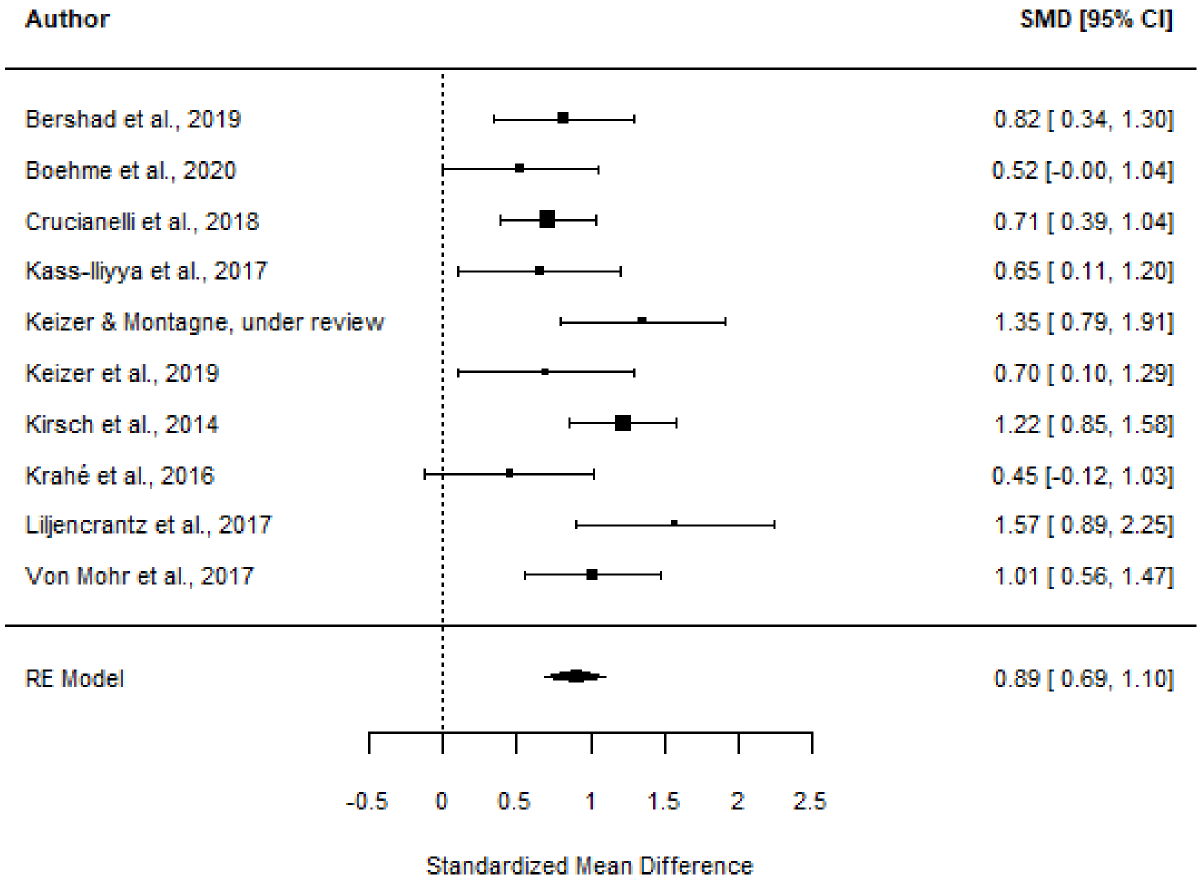
Results

Meta-analysis difference in pleasantness AT and non-AT

To test whether AT provides higher pleasantness ratings than non-AT, a random-effects meta-analysis was performed. As shown in the forest plot in Figure 2, the meta-analysis showed a significant difference in rated pleasantness between AT and non-AT, with AT rated as being more pleasant than non-AT (*10 studies*; *344 subjects*; $g = 0.89$ ($SE = 0.10$), 95% CI [0.69; 1.10], $p = < .001$). According to Cohen (1988), an effect size of 0.89 is considered as large, as 0.89 > 0.80.

Figure 2

Forest Plot difference pleasantness AT and non-AT.



Note. For each study included in the meta-analysis on the difference in pleasantness ratings between AT and non-AT, the boxes represent the study results and the horizontal lines represent the 95% confidence interval (CI) of each study result. The diamond at the bottom of the forest plot represents the estimate and thus the result when all individual studies are combined and averaged.

Heterogeneity

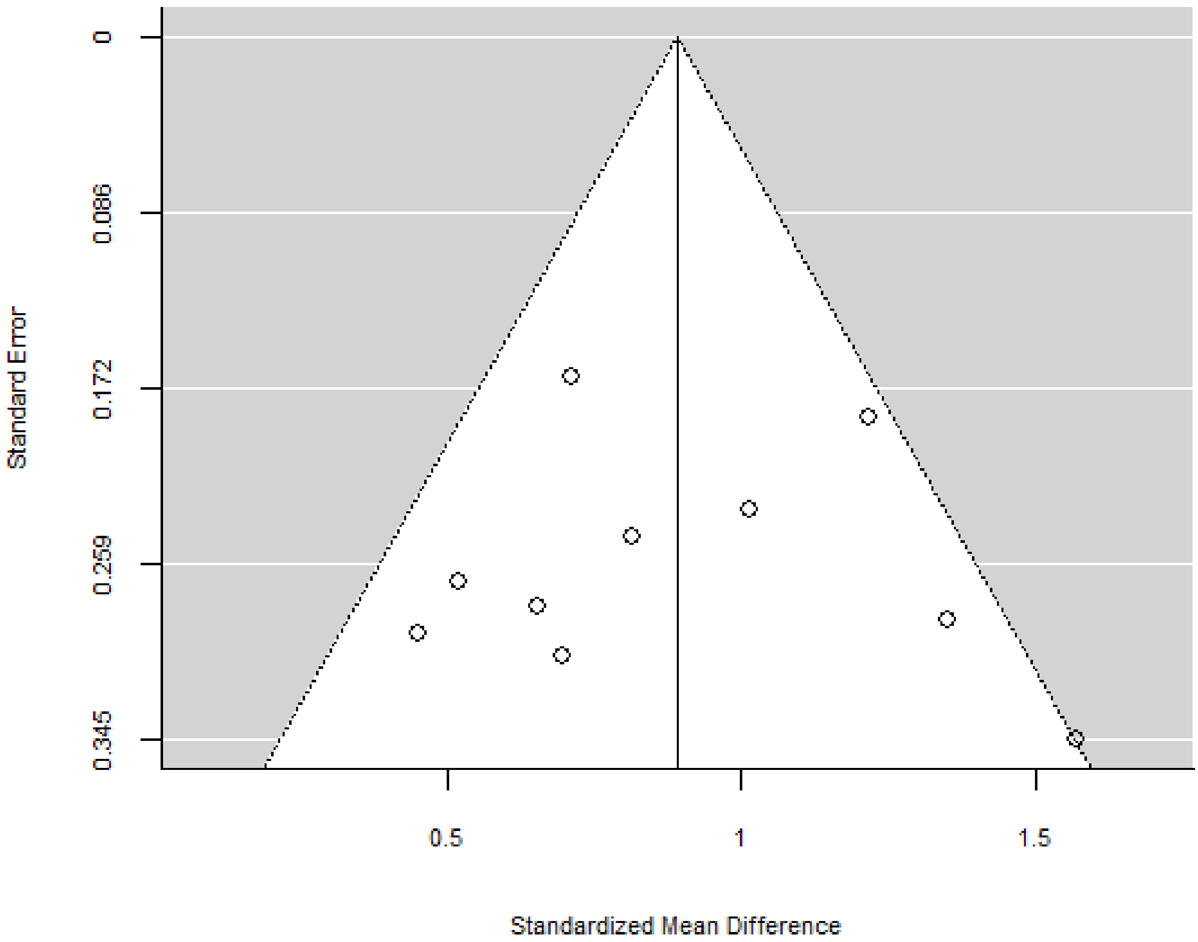
Cochran's Q test was not significant, Q (9) = 16.34, $p = 0.060$. This indicates that there is homogeneity among studies. $I^2 = 43.00\%$, which is < 50% and thus indicates moderate heterogeneity. Thus both Q and I^2 statistics do not indicate high heterogeneity among studies. There were no potential outliers in this meta-analysis and one-study-removed analyses showed that there were no influential cases.

Publication bias

Looking at the funnel plot in Figure 3, there was no evidence for asymmetry, which indicates that publication bias is not present. Also no publication bias was indicated by Egger's regression test (z = 0.25, p = 0.803) and Kendall's rank correlation test (Kendall's tau = 0.02, p = 1.000), which were both non-significant.

Figure 3

Funnel Plot AT – non-AT



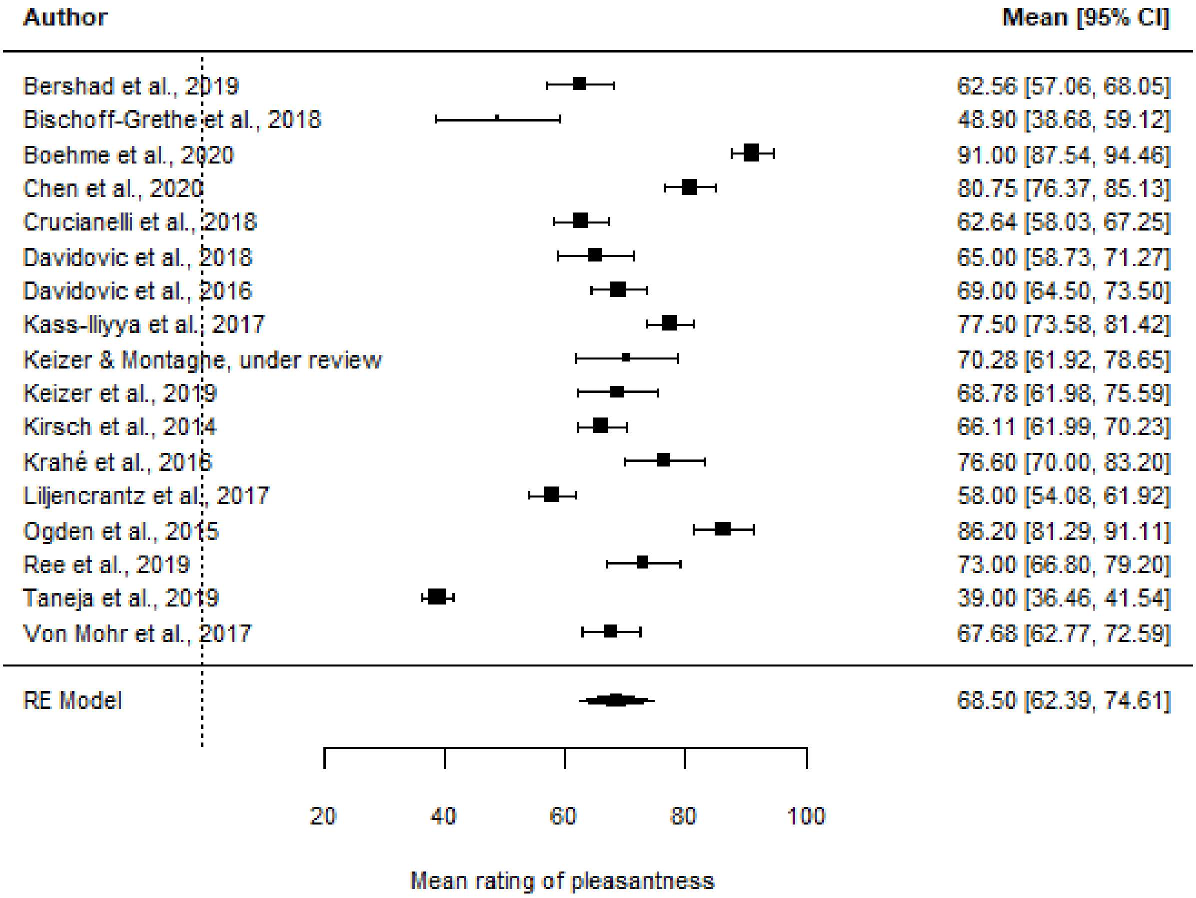
Note. Each dot represents an individual study. The x-axis represents the effect size, which is the standardized mean difference. The y-axis represents the standard error of the effect estimate, with larger studies placed at the top of the plot and smaller studies placed more at the bottom of the plot.

Meta-analysis pleasantness AT

To test what the mean rating of pleasantness for AT is, a random-effects meta-analysis was performed. As shown in the forest plot in Figure 4, the meta-analysis for AT showed a significant effect size of 68.50 (*SE* = 3.12) (*17 studies, 547 subjects,* 95% CI [62.39; 74.61] , p = <.001). This means that on a scale from 0 (unpleasant) – 100 (pleasant), participants averagely rated the pleasantness of AT with a score of 68.50.

Figure 4

Forest Plot pleasantness AT



Note. For each study included in the meta-analysis on AT, the boxes represent the study results and the horizontal lines represent the 95% confidence interval (CI) of each study result. The diamond at the bottom of the forest plot represents the estimate and thus the result when all individual studies are combined and averaged.

Heterogeneity

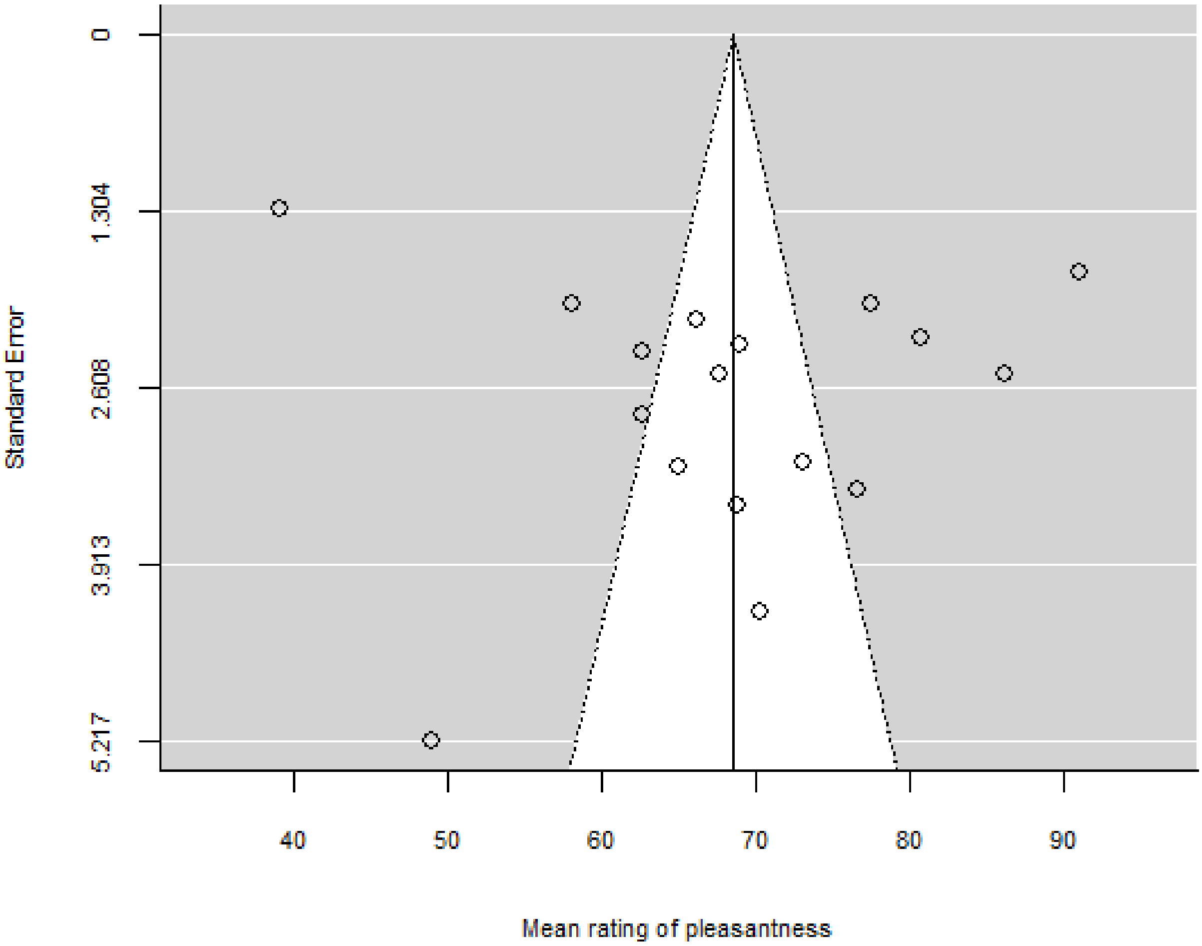
Cochran's Q test was statistically significant, Q (16) = 824.82, p = < .001. This indicates that there is heterogeneity among studies. I^2 = 96.55%, which is > 75% and thus indicates high heterogeneity. Thus both Q and I^2 statistics indicate heterogeneity among studies. The study of Taneja et al. (2019) was a potential outlier in this meta-analysis and one-study-removed analyses showed that the study of Taneja et al. (2019) also was an influential case. The results without the most influential study were 70.51, 95% CI [65.40; 75.62] , p = .000, I^2 = 93.965.

Publication bias

Looking at the funnel plot in Figure 5, there was little evidence for asymmetry. However, Egger's regression test (z = -0.40, p = 0.691) and Kendall's rank correlation test (Kendall's tau = -0.0221, p = 0.902) did not detect the presence of publication bias, as they were both non-significant.

Figure 5

Funnel Plot AT



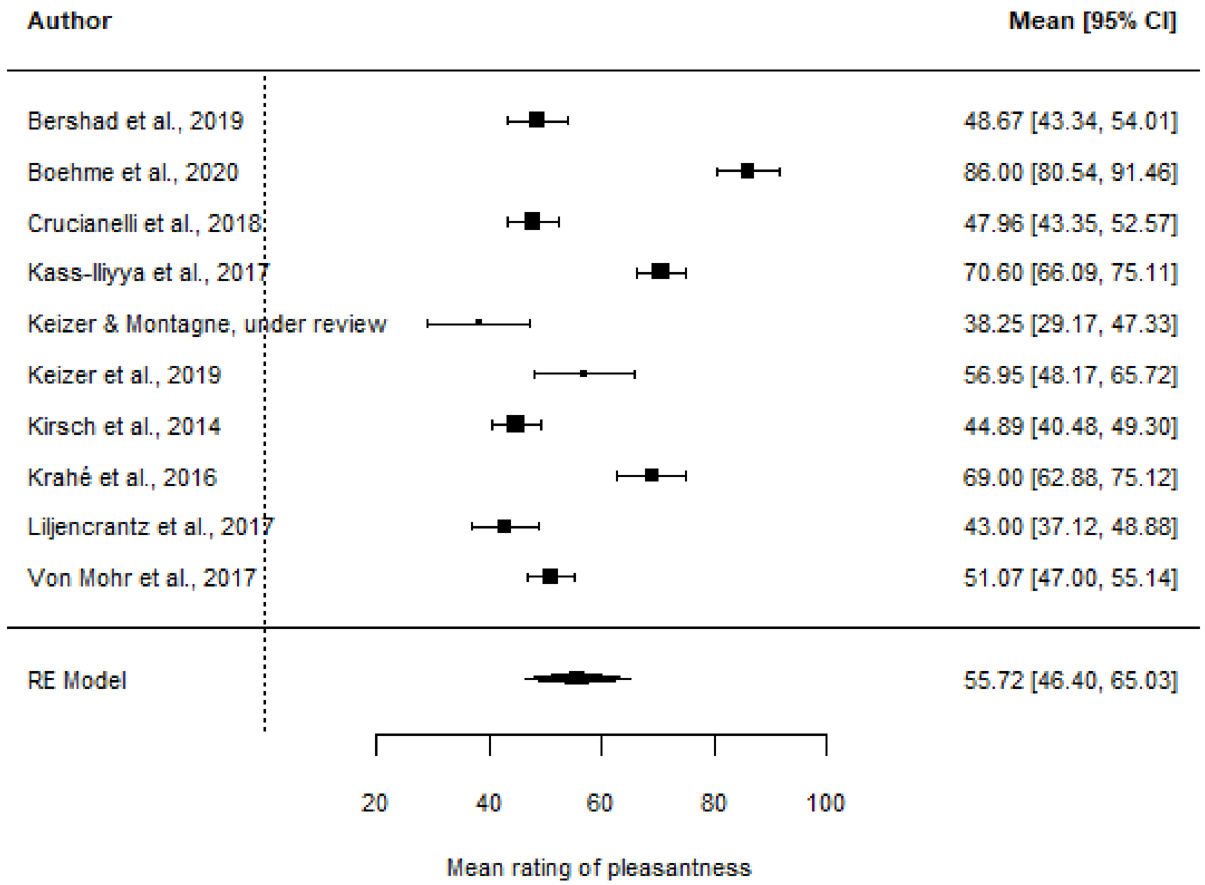
Note. Each dot represents an individual study. The x-axis represents the effect size, which is the mean rating of pleasantness. The y-axis represents the standard error of the effect estimate, with larger studies placed at the top of the plot and smaller studies placed more at the bottom of the plot.

Meta-analysis pleasantness non-AT

To test what the mean rating of pleasantness for non-AT is, a random-effects meta-analysis was performed. As shown in the forest plot in Figure 6, the meta-analysis for non-AT showed an effect size of 55.72 (SE = 4.75) (*10 studies*, *377 subjects*, 95% CI [46.40; 65.03], p = < .001). This means that on a scale from 0 (unpleasant) – 100 (pleasant), participants averagely rated the pleasantness of non-AT with a score of 55.72.

Figure 6

Forest Plot pleasantness non-AT



Note. For each study included in the meta-analysis on non-AT, the boxes represent the study results and the horizontal lines represent the 95% confidence interval (CI) of each study result. The diamond at the bottom of the forest plot represents the estimate and thus the result when all individual studies are combined and averaged.

Heterogeneity

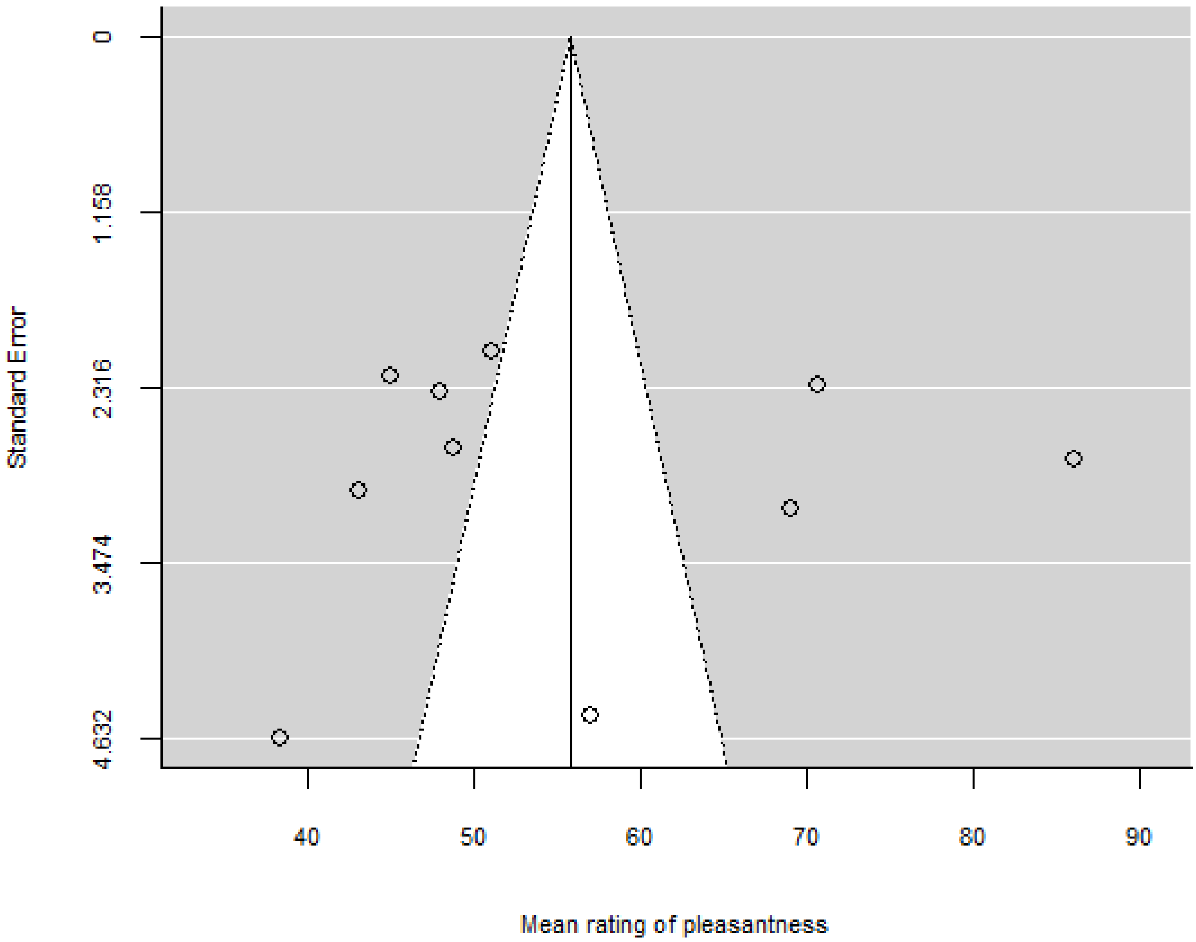
Cochran's Q test was statistically significant, Q (9) = 256.10, p = < .001. This indicates that there is heterogeneity among studies. I^2 = 96.68%, which is > 75% and thus indicates high heterogeneity. Thus both Q and I^2 statistics indicate heterogeneity among studies. The study of Boehme et al. (2020) was a potential outlier in this meta-analysis and one-study-removed analyses showed that the study of Boehme et al. (2020) also was an influential case. The results without the most influential study were 52.37 (SE = 3.73), 95% CI [45.06; 59.67] , p = .000, I^2 = 93.97.

Publication bias

Looking at the funnel plot in Figure 7, there was little evidence for asymmetry. However, both Egger's regression test (z = -0.51, p = 0.613) and Kendall's rank correlation test (Kendall's tau = 0.02, p = 1.000) did not detect the presence of publication bias.

Figure 7

Funnel Plot non-AT



Note. Each dot represents an individual study. The x-axis represents the effect size, which is the mean rating of pleasantness. The y-axis represents the standard error of the effect estimate, with larger studies placed at the top of the plot and smaller studies placed more at the bottom of the plot.

Moderator analyses

Moderator analyses were performed to assess whether certain factors influence the mean rating of pleasantness of AT. Three meta-regressions were conducted for each group of moderator variables separately (participant characteristics, stimulation characteristics and answer characteristics). In Table 3, the results of the meta-regression moderator analyses are presented.

Table 3

Results of the moderator analyses

	k	**Estimate (SE)**	***p***[a]	**95% CI**	**F (df1, df2)**	***p***	**τ^2 res (SE)**	**R^2**
Participant characteristics	17				F(df1 = 2, df2 = 14) = 0.85	0.449	160.26 (63.77)	0.00
Intercept	17	62.81 (12.71)	0.000	[35.55; 90.08]				
Age	17	0.35 (0.30)	0.262	[-0.29; 0.97]				

Percentage women	17	-0.05 (0.11)	0.641	[-0.29; 0.18]				
Stimulation characteristics	17				F(df1 = 8, df2 = 8) = 1.66	0.245	114.14 (61.63)	27.34
Intercept	17	61.94 (8.44)	<.001	[42.48; 81.40]				
Velocity	17	2.74 (2.24)	0.255	[-2.41; 7.90]				
Location: Forearm (ref)	13							
Location: Forearm and shins	1	-12.16 (11.52)	0.322	[-38.72; 14.39]				
Location: Hand	1	0.12 (12.12)	0.992	[-27.83; 28.08]				
Location: Infraorbital	1	-31.16 (11.41)	0.026*	[-57.48; 4.84]				
Location: Thigh	1	1.58 (11.97)	0.898	[-26.01; 29.17]				
Stimulation type: brush (ref)	15							
Stimulation type: Fingertips	1	-4.05 (11.53)	0.735	[-30.65; 22.55]				
Stimulation type: Fleece	1	18.46 (15.88)	0.279	[-18.16; 55.07]				
Administrator: experimenter (ref)	15							
Administrator: robotic device	2	-2.42 (12.17)	0.847	[-30.49; 25.65]				
Answer characteristics	17				F(df1 = 3, df2 = 13) = 0.18	0.917	186.76 (SE 76.31)	0.00
Intercept	17	73.63 (13.03)	<.001	[45.49; 101.77]				
Answer: unknown (ref)	4							
Answer: verbally	2	-8.09 (12.03)	0.513	[-34.09; 17.90]				
Answer: written	11	-4.11 (8.34)	0.631	[-22.13; 13.92]				
Questions: multiple (ref)	2							
Questions: one	15	-1.73 (11.02)	0.878	[-25.54; 22.08]				

Note. k = total number of studies and effect sizes, Estimate (*SE*) = estimate and its standard error, p^a = p-value of moderators, 95% CI = confidence interval estimate, F(df1, df2) = F-test and degrees of freedom, p^b = p-value of the omnibus test, τ^2 res (*SE*) = estimated amount residual of heterogeneity and its standard error, R^2 = proportion of amount of heterogeneity accounted for. *** =** significant < .05.

Participant characteristics

Participant characteristics did not moderate the findings, as the omnibus test for all regression coefficients was not significant (p = 0.449). It accounted for 0.00% of the amount of heterogeneity. Both age (p = 0.262) and sex distribution (p = 0.641) were no significant moderators.

Stimulation characteristics

Stimulation characteristics did not moderate the findings, as the omnibus test for all regression coefficients was not significant (p = 0.245) . It accounted for 27.34% of the amount of heterogeneity. It appeared that stroking at the infraorbital region is significantly associated with a lower rating of pleasantness (p = 0.026) than studies where the touch was applied at the forearm, with a difference in pleasantness rating of -31.16. Furthermore, velocity, stimulation type and administrator were no significant moderators.

Answer characteristics

Answer characteristics did not moderate the findings, as the omnibus test for all regression coefficients was not significant (p = 0.917). It accounted for 0.00% of the amount of heterogeneity. Both answer and questions were no significant moderators.

Discussion

The aim of the present study was to quantify the difference in perceived pleasantness between affective touch (AT) and non-affective touch (non-AT). While AT is characterised by caress-like stroking with low velocities, non-AT is applied with faster stroking velocities (Löken et al., 2009). In recent years, multiple studies already concluded that AT is perceived as more pleasant than non-AT (e.g., Pawling et al., 2017; Sehlstedt et al., 2016). However, this had never been confirmed through a meta-analysis. Currently, only one meta-analysis exists that focuses on perceived pleasantness of AT, but they investigated the difference in perceived pleasantness of AT between men and women (Russo et al., 2020) and not the difference in perceived pleasantness between AT and non-AT. To fill this gap, the current study performed meta-analyses to investigate the difference in experienced pleasantness between AT and non-AT. First, a high positive effect size was found for the difference in perceived pleasantness between AT and non-AT, indicating that AT is experienced as more pleasant than non-AT. Hence, the hypothesis that AT is perceived as more pleasant than non-AT was supported by the data and these findings are in line with previous research (e.g., Pawling et al., 2017; Sehlstedt et al., 2016). Secondly, the current study calculated mean pleasantness ratings for both AT and non-AT. This mean rating is a baseline measure of the perceived pleasantness of AT, as studies were not included if pleasantness ratings were obtained during the performance of a task. More importantly, this baseline measure could be considered as a baseline of how AT and non-AT were experienced before the COVID-19 pandemic, because the studies included were performed before the pandemic. Finally, the current study provided insights into methodological aspects that could influence the perceived pleasantness of AT.

Several factors might contribute to the difference in perceived pleasantness between AT and non-AT. First, AT is used in affiliative interactions between individuals (Olausson et al., 2010) and is thought to communicate affection and trust (Hertenstein et al., 2006). CT activation caused by this caress-like stimulation enhances socio-emotional processes in the brain (Schirmer & Gunter, 2017) and activates the posterior insula, which is important for emotional experiences (Singer et al., 2009), self-awareness (Baier & Karnath, 2008) as well as homeostatic balance (Craig, 2009). On the other hand, non-AT, which is more about discriminative aspects of touch, has an identifying role and is used to make rapid decisions to guide behaviour (McGlone et al., 2014). Non-AT activates brain regions like the primary somatosensory cortex (Olausson et al., 2002; Morrison, 2016a). It seems that even in early postnatal life, the CT system is already functional and able to differentiate between AT and non-AT. Moreover, AT results in stronger cortical activation than non-AT in infants (Jönsson et al., 2018) and interestingly, AT is perceived as more pleasant than non-AT at a young age (Sehlstedt et al., 2016). This highlights that AT is important in early life and that already at a young age, a clear distinction between AT and non-AT in processing and hedonic values is present. Evidently, there is a clear distinction between AT and non-AT on multiple levels, which is already present in early life. Therefore, it might not be surprising that one perceives AT as being more pleasant than non-AT, shown by previous research and confirmed by the current meta-analysis.

However, it seems that the perception of pleasantness of AT is not only dependent on the CT system, because AT on the glabrous skin, where CT fibres are not present, can also be perceived as pleasant (Löken et al., 2011). Even though this is perceived as less pleasant than stimulation on the hairy skin (Ackerley et al., 2014a), stimulation on the glabrous skin is still rated as being pleasant (Löken et al., 2011). As the current study only included studies where stimulation was applied on the hairy and not on the glabrous skin, no conclusions could be drawn about perceived pleasantness of AT on the glabrous skin. For future research it would therefore be interesting to perform a meta-analysis that compares perceived pleasantness of stimulation on the hairy versus on the glabrous skin and explore what factors contribute to the difference in perceived pleasantness.

Although it has thus been found that people generally perceive AT as being pleasant, the perception of AT can also be disturbed. For instance, Crucianelli et al. (2016) found that patients with anorexia nervosa perceive AT as less pleasant than healthy controls. Interestingly, patients with Parkinson's disease rate AT higher on pleasantness than control subjects (Kass-Iliyya et al., 2017). This shows that in clinical populations, pleasantness of AT can both be rated lower and higher compared to controls. There also seems to be altered perception of AT in non-clinical populations, as people with a history of traumatic parental bonds or a disorganized attachment pattern perceive AT as being unpleasant (Spitoni et al., 2020). In addition, insecure attachment is associated with reduced pleasantness discrimination between AT and non-AT (Krahé et al., 2018). Evidently, several studies have focused on altered AT perception in (non-)clinical populations, but the results of the current study can only be generalized to a healthy adult population. Therefore, a suggestion for future research would be to perform a meta-analysis that investigates differences in perceived pleasantness between psychiatric patients and healthy controls. This would not only provide insight into altered perception of AT in psychiatric conditions, but it would as well give insight into the transdiagnostic characteristics of disturbed AT perception.

A second aim of this study was to investigate whether several moderators would influence the perceived pleasantness of AT. The moderator variables were grouped into three categories. In the category participant characteristics, age did not influence the perceived pleasantness of AT, which is not in line with previous research of Sehlstedt et al. (2016), who found that older people experience AT as more pleasant than younger people. An explanation for a different result in the current study could be that most samples of the included studies consisted of participants under the age of 30 and thus no huge age differences were present between the samples, leading to less differentiation in pleasantness ratings. Also, it was found that the percentage of women did not influence the experienced pleasantness. However, Russo et al. (2020) found that women perceive AT as more pleasant than non-AT. This would indicate that if the percentage of women is higher, the perceived pleasantness would also be higher, which was not found in the current study. This inconsistency could be due to differences in the means of comparing, as Russo et al. (2020) directly compared perceived pleasantness of AT in men to perceived pleasantness of AT in women, while the current study looked at whether the percentage of women influenced pleasantness ratings of AT. In the second category of moderators, stimulation characteristics, none of the moderators influenced the perceived pleasantness of AT, except that stimulation applied to the infraorbital region was perceived as less pleasant than stimulation applied to the forearm. This result should be interpreted cautiously, because only one out of seventeen included studies applied touch to the infraorbital region. In the final category of moderators, answer characteristics, none of the moderators influenced the perceived pleasantness. Overall, this study gives some starting points for future research on methodological aspects involved in the perceived pleasantness of AT.

Interestingly, the current study provides some indications that the source of the AT does not influence the rating of pleasantness. This is especially interesting given the current situation regarding the COVID-19 virus during which performing interpersonal touch research has been difficult. For exploring purposes, the current study investigated whether observing AT could yield similar pleasantness ratings as physically experiencing AT. A mean rating of pleasantness on observed AT provided by our previously performed online study was descriptively compared to the mean pleasantness rating on physically experienced AT provided by the current meta-analysis. The results showed that observing AT (M = 66.12) and physically experiencing AT (M = 68.50) result in similar pleasantness ratings (See Appendix C for the analysis), which is also in line with previous research performed by Morrison et al. (2011). In addition, the same kinds of brain activation have been found for physically experienced and for observed AT (Ebisch et al., 2011). Indeed, the posterior insula is activated by both the physical experience as well as the observation of AT (Morrison et al., 2011). As these two sources of AT result in similar pleasantness ratings as well as in similar brain activity, one might suggest that they could have the same kinds of positive effects. This finding could be interesting for touch deprived people, such as the elderly, people in prison or people in palliative care, because they might benefit from the positive effects of AT by simply observing touch. However, as this is just a speculation, more research is needed to precisely determine what the positive effects of observing AT are and whether these effects are similar to those of physically experiencing AT.

A limitation of the current study that should be taken into account when interpreting the results is the problem of publication bias, which means that journals have the tendency to only publish studies with significant results (Rosenthal, 1979). Even though the current study included one unpublished study (Keizer & Montagne, under review) and showed that the results were not influenced by publication bias, not including non-significant study results could still have biased the mean pleasantness ratings of AT and non-AT, as well as the estimate for the difference between the pleasantness of AT and non-AT. However, assessing the difference in perceived pleasantness between AT and non-AT was often not the main goal of the studies included in the current meta-analysis and most studies just reported the mean ratings without testing for differences. This means that studies that did not find significant differences in experienced pleasantness between AT and non-AT might have been included, which in turn might have reduced possible publication bias in the current study. Also should be noted is that only a limited number of studies were available for the present meta-analysis, as not all included studies provided the right statistics that were needed to perform the meta-analyses. If all studies that investigated perceived pleasantness of (non-)AT would have been included, this would have led to more accurate and precise estimates.

Even though these limitations have to be taken into account when interpreting the results of the current meta-analysis, this study added significant value to the existing literature regarding the perception of (non-)AT for several reasons. First, it is the first meta-analysis that showed that AT is perceived as more pleasant than non-AT. More importantly, this is the first study to provide a mean rating of pleasantness of AT and non-AT, which can be used in future research to make comparisons. This mean rating of pleasantness is not only a baseline of how people perceive (non-)AT without simultaneously performing a task, it is also a baseline of how people perceived (non-)AT before the COVID-19 pandemic. Possibly, touch will never be experienced the same as before this pandemic. Indeed, there are already some indications that people who are exposed less to touch rate touch as being less pleasant than people that were exposed more to touch (Sailer & Ackerley, 2019). Hence, an interesting area for future research would be to examine the effects of touch deprivation due to the pandemic on our touch perception, which could be investigated by comparing the baseline pleasantness ratings provided by the current study to new obtained pleasantness ratings. Lastly, the current study provided more insight into methodological aspects that might influence pleasantness ratings and that should be taken into account when performing AT research.

Taken together, the current study performed meta-analyses to examine the difference in perceived pleasantness between AT and non-AT in healthy adults. It was found that AT is perceived as more pleasant than non-AT. Moreover, this study provided baseline pleasantness ratings of both AT and non-AT that can be used in future research to make comparisons, for example in research investigating the effects of touch deprivation due to the COVID-19 pandemic on the perception of touch. Finally, this study assessed whether several moderators influenced the experienced pleasantness of AT and gave indications that observing AT could yield similar pleasantness ratings as physically experiencing AT. Overall, the present study provided more insight into the hedonic aspects of AT and gave some helpful starting points for future research.

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Appendices

Appendix A

Scale conversions

The converted mean (M_{new}) and converted standard deviation (SD_{new}) were calculated by the following formulas. In these formulas, M_{old} is the raw mean of the study and SD_{old} is its standard deviation.

$M_{new} = a * M_{old} + b$

$SD_{new} = a * SD_{old}$

a and b were calculated by solving the following equations:

$a * lowerbound_{old} + b = lowerbound_{new}$

$a * upperbound_{old} + b = upperbound_{new}$

For all studies, $lowerbound_{new} = 0$ and $upperbound_{new} = 100$, as each scale should be converted to 0 (unpleasant) – 100 (pleasant).

An example of these formulas is as follows. Davidovic et al. (2018) assessed pleasantness using a scale from -5 (unpleasant) – 5 (pleasant). $Lowerbound_{old} = -5$ and $upperbound_{old} = 5$. Thus, to calculate a and b, the following equations should be solved:

$a * -5 + b = 0$ and $a * 5 + b = 100$, resulting in $a = 10$ and $b = 50$.

Thus the following formulas should be filled in: $M_{new} = 10 * M_{old} + 50$ and $SD_{new} = 10 * SD_{old}$.

$M_{new} = 10 * 1,5 + 50 = 65$

$SD_{new} = 10 * 1,6 = 16$

Appendix B

Codes RStudio

```
# -------------------- ANOVA -------------------
# Install packages
install.packages("anova")
install.packages(c("ggplot2", "ggpubr", "tidyverse", "broom", "AICcmodavg"))

# Package Anova ophalen
library(anova)

# Data inladen in R
data <- Schalen_vergelijken
View (data)

# Data converten
data$Scale <- as.factor(as.numeric(data$Scale))

# ANOVA uitvoeren
one.way <- aov(Pleasantness ~ Scale, data = data)
summary(one.way)

# Post-hoc tests
TukeyHSD(one.way)

# ------------------- META-ANALYSES -------------------

# Loading of necessary packages
library(metafor)
library(readxl)
library(dplyr)

# Loading of data in R and placing it in object "data"
Meta_analyse_final_excel <- read_excel("Meta-analyse final excel.xlsx")
data <- Meta_analyse_final_excel
View (data)

# Conversions of data to correct scale
data$Location <- as.factor(as.character(data$Location))
data$Side <- as.factor(as.character(data$Side))
data$Stimulation <- as.factor(as.character(data$Stimulation))
data$Administration <- as.factor(as.character(data$Administration))
data$Age <- as.numeric(as.character(data$Age))
data$Schaal <-as.factor(as.character(data$Schaal))
data$Answer <-as.factor(as.character(data$Answer))
data$Visible <-as.factor(as.character(data$Visible))
data$Questions <-as.factor(as.character(data$Questions))
str(data)



#  ---------------- Meta-analysis difference AT and non-AT ----------------
# Create new data for AT - non-AT
data_dif <- dplyr::filter(data, Author %in% c("Krahé et al.",
```

```
                                "Boehme et al.",
                                "Bershad et al.",
                                "Crucianelli et al.",
                                "Kirsch et al.",
                                "Liljencrantz et al.",
                                "Kass-Iliyya et al.",
                                "Von Mohr et al.",
                                "Keizer et al.",
                                "Keizer & Montagne"))
View(data_dif)

# Calculate effect sizes
data_dif <- escalc(measure = "SMD", m1i = M_ct_n, sd1i = SD_ct_n, n1i = N,
             m2i = M_ctnon_n, sd2i = SD_ct_n, n2i = N,
             data = data_dif)
data_dif

# Random effects
meta_dif <- rma(yi, vi, data = data_dif)
meta_dif
predict(meta_dif)

# Forest plot
forest(meta_dif,
    slab = paste(data_dif$Author, data_dif$Year, sep = ", "),
    header = 'Author', #Author as header
    cex = 0.7) #Size letters

# Publication bias
# Funnel plot
funnel(meta_dif, pch = 1, cex = 1.1, cex.lab = 0.7, cex.axis = 0.7)

# Egger's regression test, these two give same results
regtest(meta_dif, model="rma")
reg_dif <- regtest(data_dif$yi, data_dif$vi)
reg_dif

# Rank correlation, Kendall's tau test, these two give same results
rank_dif <- ranktest(data_dif$yi, data_dif$vi)
rank_dif
ranktest(meta_dif)

# Influence analysis
inf_dif <- influence(meta_dif)
inf_dif
plot(inf_dif, plotdfb = TRUE)
cooks.distance(meta_dif)

# Influence analysis when no moderators
leave1out(meta_dif, digits = 3)



#  -------------------- Meta-analysis AT  --------------------
# Calculate effect sizes of CT + put in new object "data_ct"
```

```
data_ct <- escalc(measure = "MN", mi = M_ct_n, sdi = SD_ct_n, ni = N, data = data)
data_ct
View(data_ct)

# Random effects meta-analysis
meta_ct <- rma(yi, vi, data = data_ct)
meta_ct
predict(meta_ct)

# Forest plot
forest(meta_ct,
       slab = paste(data_ct$Author, data_ct$Year, sep = ", "),
       header = 'Author', #Author as header
       xlab = "Mean rating of pleasantness", #Name x-axis
       cex = 0.7) #Size letters

# Publication bias
# Funnel plot
funnel(meta_ct, pch = 1, cex = 1.1, cex.lab = 0.7, cex.axis = 0.7, xlab = "Mean rating of pleasantness")

# Egger's regression test, these two are the same
regtest(meta_re_ct, model="rma")
reg_ct <- regtest(data_ct$yi, data_ct$vi)
reg_ct

# Rank correlation, Kendall's tau test
rank_ct <- ranktest(data_ct$yi, data_ct$vi)
rank_ct
ranktest(meta_re_ct)

# Influence analysis
inf_ct <- influence(meta_ct)
inf_ct
plot(inf_ct, plotdfb = TRUE)
cooks.distance(meta_dif)

# Influence analysis when no moderators
leave1out(meta_ct, digits = 3)



# -------------------- Moderator analyses -------------------------
# Participant characteristics
meta_mod_part <- rma(yi, vi, mods = ~ Age + Perc_women,
                     data = data_ct, knha = TRUE)
meta_mod_part


# Stimulation characteristics
meta_mod_stim <- rma(yi, vi,
                     mods = ~ Vel_ct + Location + Stimulation + Administration,
                     data = data_ct, knha = TRUE)
meta_mod_stim

# Answer characteristics
```

```
meta_mod_ans <- rma(yi, vi, mods = ~ Answer + Questions,
                data = data_ct, knha = TRUE)
meta_mod_ans



#  ------------------- Meta-analysis non-AT  --------------------
# Create new data for non-AT
data_ctnon <- dplyr::filter(data, Author %in% c("Krahé et al.",
                                        "Boehme et al.",
                                        "Bershad et al.",
                                        "Crucianelli et al.",
                                        "Kirsch et al.",
                                        "Liljencrantz et al.",
                                        "Kass-Iliyya et al.",
                                        "Von Mohr et al.",
                                        "Keizer et al.",
                                        "Keizer & Montagne"))
View(data_ctnon)

# Calculate effect sizes of CT + put in new object "data_ctnon"
data_ctnon <- escalc(measure = "MN", mi = M_ctnon_n, sdi = SD_ctnon_n, ni = N, data =
data_ctnon)
data_ctnon

# Random effects meta-analysis
meta_ctnon <- rma(yi, vi, data = data_ctnon)
meta_ctnon
predict(meta_ctnon)

# Forest plot
forest(meta_ctnon,
     slab = paste(data_ctnon$Author, data_ctnon$Year, sep = ", "),
     header = 'Author', #Author as header
     xlab = "Mean rating of pleasantness", #Name x-axis
     cex = 0.7) #Size letters

# Publication bias
# Funnel plot
funnel(meta_ctnon, pch = 1, cex = 1.1, cex.lab = 0.7, cex.axis = 0.7, xlab = "Mean rating of
pleasantness")

# Egger's regression test, these two are the same
regtest(meta_ctnon, model="rma")
reg_ctnon <- regtest(data_ctnon$yi, data_ctnon$vi)
reg_ctnon

# Rank correlation, Kendall's tau test
rank_ctnon <- ranktest(data_ctnon$yi, data_ctnon$vi)
rank_ctnon
ranktest(meta_ctnon)

# Influence analysis
inf_ctnon <- influence(meta_ctnon)
inf_ctnon
```

```
plot(inf_ctnon, plotdfb = TRUE)
cooks.distance(meta_ctnon)

# Influence analysis when no moderators
leave1out(meta_ctnon, digits = 3)
```

Appendix C

Differences in pleasantness experienced AT and observed AT

Methods

From April to September of 2020, we conducted an online study to investigate touch deprivation due to the COVID-19 pandemic. Also investigated was how participants rated videos of (non-)AT on pleasantness. The data from this study was used to calculate a mean rating of pleasantness of observed AT and this was compared to the mean rating of pleasantness of experienced AT that was produced by the meta-analysis.

Participants

In this online study, a total of 2630 participants completed the questions that concerned the pleasantness of the videos of AT with ages ranging from 16 – 87 (M = 37.54, SD = 15.33). The majority of the participants were female (n = 2001).

Touch Perception Task

The participants were presented with two 10s videos of either AT (3 cm/s) or non-AT (18 cm/s) applied to the forearm. After seeing each video, participants filled out a Touch Perception Questionnaire (Table 4) which consisted of five questions which were answered on a scale from 0 (very unpleasant/ uncomfortable) – 10 (very pleasant/ comfortable). The questions that were used for this study are 1:*"How did the videoclip make you feel?"* and 4:*"How would you rate the videoclip?"*. Question 2, 3 and 5 were not included, because these questions are not comparable to the assessed pleasantness of the real life experienced AT. A mean score of question 1 and 4 was calculated to comprise a mean rating of pleasantness of the observed AT.

Table 4

Touch Perception Questionnaire

Question	Answer
1. How did the videoclip make you feel?	0 (very uncomfortable) – 10 (very comfortable)
2. How do you think the person giving the touch would rate the touch?	0 (very unpleasant) – 10 (very pleasant)
3. How do you think the person being touched would rate the touch?	0 (very unpleasant) – 10 (very pleasant)
4. How would you rate the videoclip?	0 (very unpleasant) – 10 (very pleasant)
5. How much would you like to be touched like that?	0 (not at all) – 10 (a lot)

Note. Above the questions, the following text was stated: Please place the slider along the line at the point which best describes your rating:

Data manipulation

In order to be able to compare the mean rating of pleasantness of observed AT to the mean rating of pleasantness of experienced AT that comes out of the meta-analysis, the means and its standard deviations should be on the same scale. As this was not the case, the mean rating of pleasantness of observed AT and its standard deviation were converted (see Appendix A for a detailed overview of the scale conversions).

Data-analysis

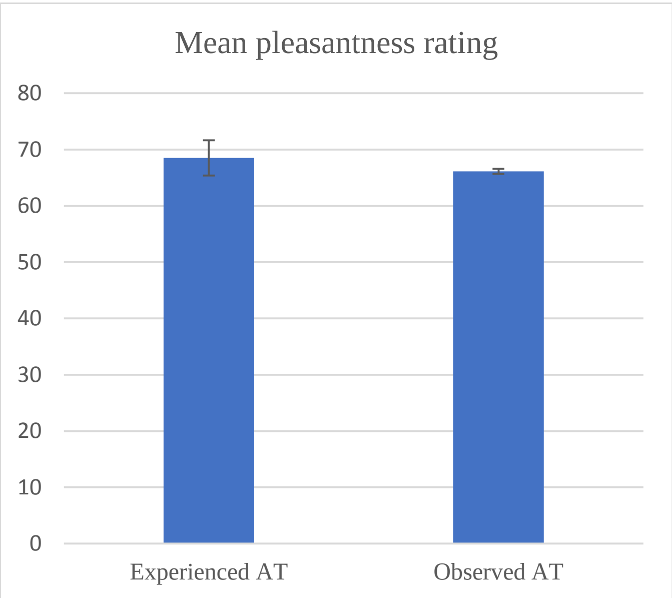
The mean rating of pleasantness of experienced AT was calculated using meta-analytic procedures and the mean rating of pleasantness of observed AT was calculated using IBM SPSS 26.0 statistics software. Because these two means of pleasantness were calculated with different statistical procedures, they are not comparable in a statistical manner. Therefore, they will be compared descriptively.

Results

To compare the mean ratings of pleasantness of experienced AT and observed AT, the means were descriptively compared. Provided by the meta-analysis on the pleasantness of AT, it was found that participants rate experienced AT, on a scale from 0 (unpleasant) – 100 (pleasant), with an average of *M* = 68.50 (*SE* = 3.12). Provided by our previous unpublished study, it was found that participants rate observed AT, on a scale from 0 (unpleasant) – 100 (pleasant), with an average of *M* = 66.12 (*SE* = 0.45). As shown in Figure 8, the two means do not differ much from each other in a descriptive manner. This means that experienced AT and observed AT yield similar pleasantness ratings.

Figure 8

Mean pleasantness ratings of experienced AT and observed AT



Note. The error bars represent the standard error.