Portfolio 5: Building on the shoulders of giants: meta-analysis
by Astrid, Daniel, Jesper and Pernille KJ

https://github.com/StudiegruppeEM3/Portfolio_5/blob/master/A5_MetaAnalysis.rmd

What is the current evidence for distinctive vocal patterns in schizophrenia? Report how many papers report quantitative estimates, comment on what percentage of the overall studies reviewed they represent (see PRISMA chart) ***your method to analyze them****, the estimated effect size of the difference (mean effect size and standard error) and forest plots representing it. N.B. Only measures of pitch mean and pitch sd are required for the assignment (all the other measures have been removed from the dataset for the sake of simplicity).*

(Astrid, Pernille KJ)

From the PRISMA 2009 flow-diagram, we know that the meta-analysis included 46 papers out of 4341 studies identified which were not replicates, this means 1.06% of the total amount of studies were included.
46/4341 * 100% = 1.06%

We decided to investigate the mean value of pitch and the pitch variability. Out of the 46 studies, we found 15 studies eligible for our pitch variability analysis and 6 studies that matched for mean pitch analysis. For both analyses, we included the article ID, study ID, sample size, and type of task.

To analyze these studies, we made two different models: one for mean pitch and one for pitch variability. Firstly we calculate the standardized mean difference and the sampling variance for all the studies in both analyses. We then plot the effect sizes to investigate our data as boxplots:

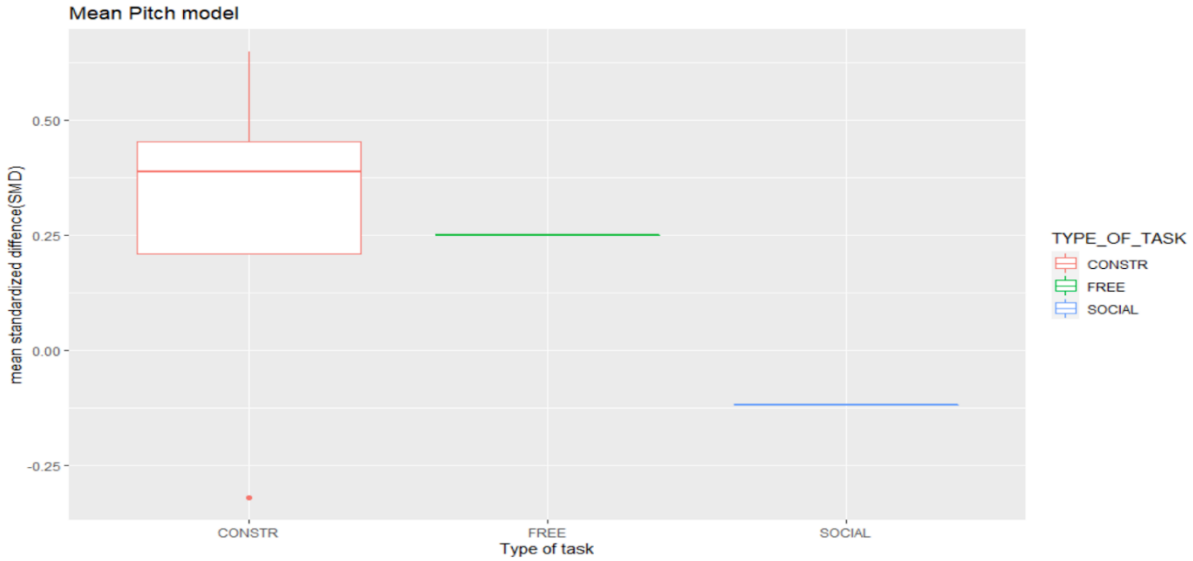


figure 1; showing a boxplot of the effect sizes for the different types of tasks for the mean pitch model

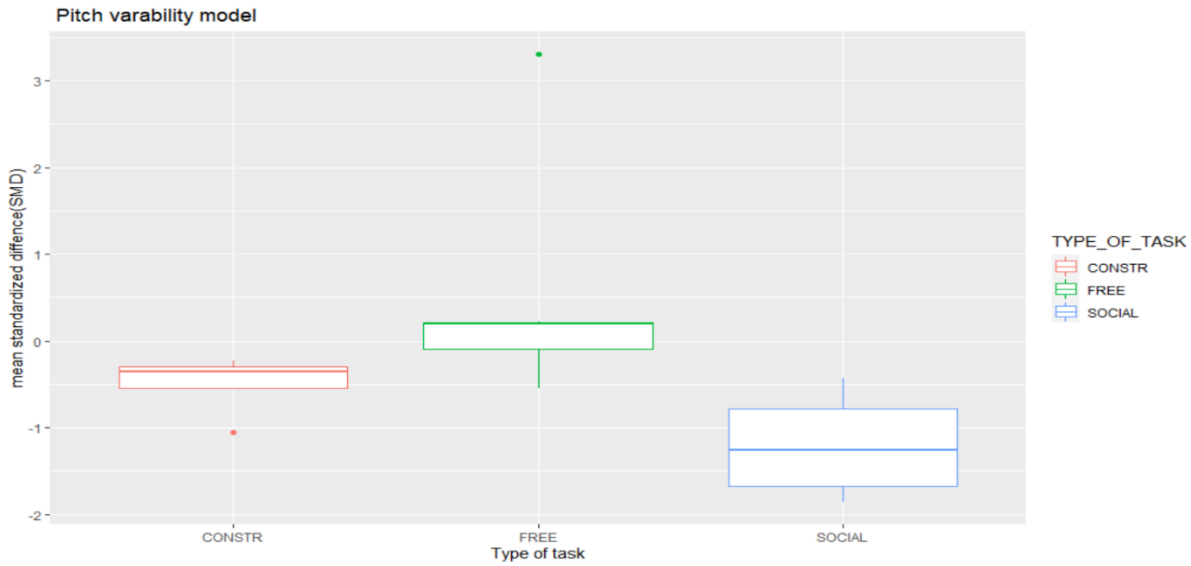


figure 2; showing a boxplot of the effect sizes for the different types of tasks for the pitch variability model

As can be seen from the boxplots above, it looks like there is an outlier in the pitch variability model in the FREE type task. We will keep this in mind when interpreting our forest plot.

Models
We made linear mixed effect models of the standardized mean difference, weighted with their sampling variance with study as a random intercept. We also made models including the type of task as a fixed effect. The results can be seen below.

linear mixed effect models with no fixed effects:
In the mean pitch model the effect size was 0.21 with a standard error of 0.15 which was calculated from 5 degrees of freedom resulting in a non-significant effect because of the p-value of 0.22

In the pitch variability model the effect size was -0.2 with a standard error of 0.36 which was calculated from 10.5 degrees of freedom resulting in a non-significant effect because of the p-value of 0.59.

linear mixed effect models with type of task as fixed effect we chose to have the constrained condition as baseline.

The mean pitch model:

	Estimate	standard error	df	t-value	p-value
Intercept	0.28	0.21	3	1.3	0.28
Task = free	-0.03	0.47	3	-0.06	0.96
Task = social	-0.40	0.47	3	-0.85	0.46

tabel 1; displays the summary output of the linear mixed effects model for mean pitch with type of task as fixed effect and study as a random intercept.

The pitch variability model:

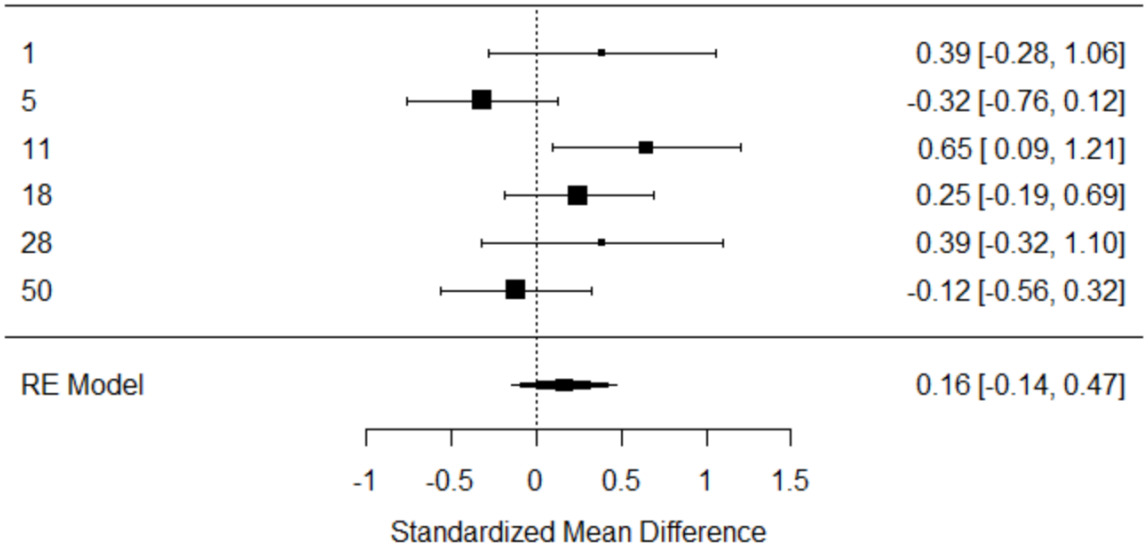
	Estimate	standard error	df	t-value	p-value
Intercept	-0.5	0.4	10.4	-1.2	0.24
Task = free	1.1	0.61	10.1	1.8	0.10
Task = social	-0.6	0.12	2.1	-4.9	0.03

tabel 2; displays the summary output of the linear mixed effects model for pitch variability with type of task as fixed effect and study as a random intercept.

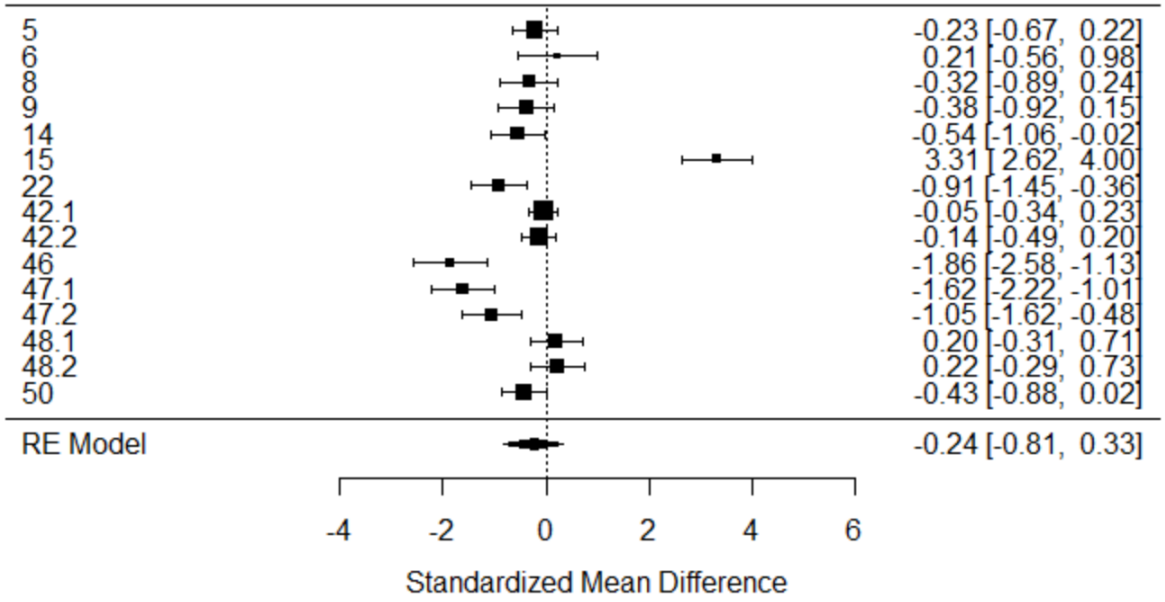
We then made use of the metaphor package to use the function rma. This function completes a meta-analysis via linear (mixed effects) models and compares the outputs of these results to the normal linear mixed effect models here we excluded type of task as a fixed effect for simplicity in our forest plots.

Using the rma function the mean pitch model's effect size became 0.16 with a standard error of 0.16
The pitch variability model's effect size became -0.24 with a standard error of 0.29

We then made forest plots for these two models.



Plot 1: forest plot of the standardized mean differences and their confidence intervals for each study for the mean pitch model.



Plot 2: forest plot of the standardized mean differences and their confidence intervals for each study for the pitch variability model with type of task as a fixed effect.

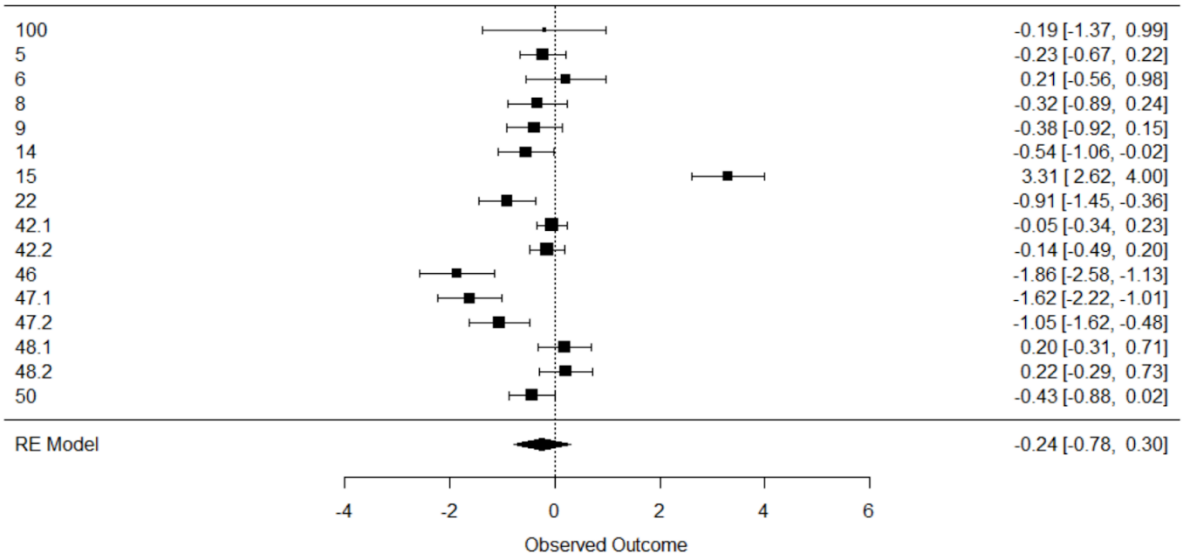
Firstly when interpreting our results we can see an obvious outlier which one might want to look further into, in the pitch variability model. Here it would be a good idea to check the specific study to see whether a typo or some other error has occurred. While including this outlier the results from our analyses show that schizophrenic patients seem to have a higher mean pitch, but this effect is very small SMD = 0.16, with a lot of uncertainty, indicated by the confidence interval of (-0.14 , 0.47).

The results also show that schizophrenic patients seem to have a lower pitch variability in contrast to what is normally hypothesised, but this effect is again very small SMD = -0.24, with a lot of uncertainty, indicated by the confidence interval of (-0.81 , 0.33).
From this initial analysis it should be concluded that there is no difference in mean pitch and pitch variability in schizophrenic patients compared to health controls. However an argument could be made for collecting more data because in the pitch variability model it seems to be the case that there could be big differences between types of tasks.

Do the results match your own analysis from Assignment 3? If you add your results to the meta-analysis, do the estimated effect sizes change? Report the new estimates and the new forest plots.

(Jesper)

Our results from assignment 3 showed that the effect size of pitch variability in schizophrenic patients compared to healthy controls was -0.19 with a standard error of 0.6, this analysis showed that this effect size was -0.24, which is very comparable, this can also be seen in the forest plot below where our results from assignment 3 has been included.



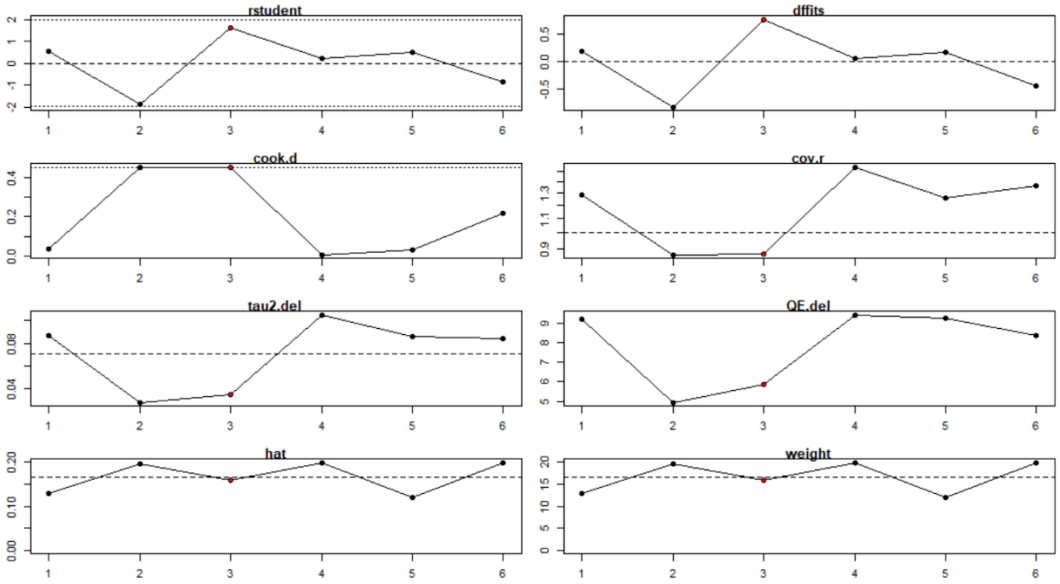
plot 3; Showing the forest plot of the meta-analysis with our assignment 3 results displayed as study 100.

when including this new data the effect size of the meta-analysis did not change SMD = -0.24, however the confidence intervals became a little tighter, (-0.78 , 0.30).

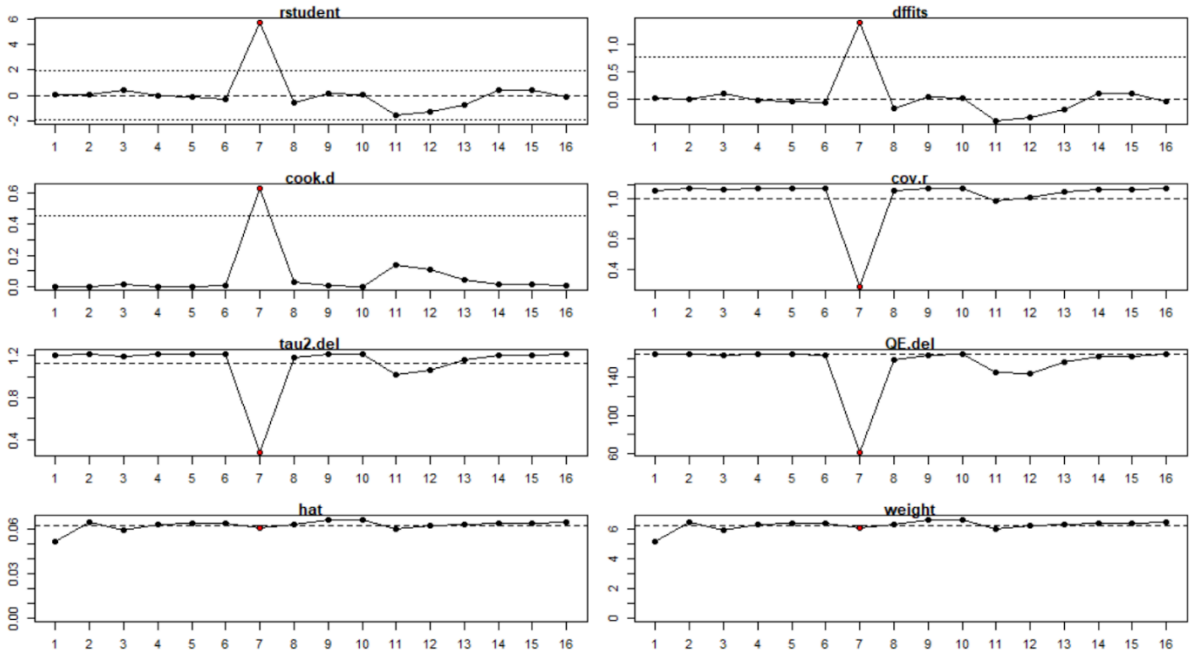
Quality assessment of the literature

Assess the quality of the literature: report and comment on heterogeneity of the studies (tau, I2), on publication bias (funnel plot), and on influential studies.

(Daniel)
To get the quality of the literature and comment on the heterogeneity of the studies we looked at the output of our meta-analysis model. For our mean pitch model the values of tau and I^2 came out to be, tau = 0.267 and I^2 = 50% while for the pitch variability model the outcome was tau = 1.1 and I^2 = 94.4%. What these values tell us is that there is a moderate amount of heterogeneity in the mean pitch model and very high heterogeneity in the pitch variability model. This very high variance in the studies in the pitch variability model is partly due to the outlier we detected earlier. We can also see this outlier in plot XXX for the pitch variability model.

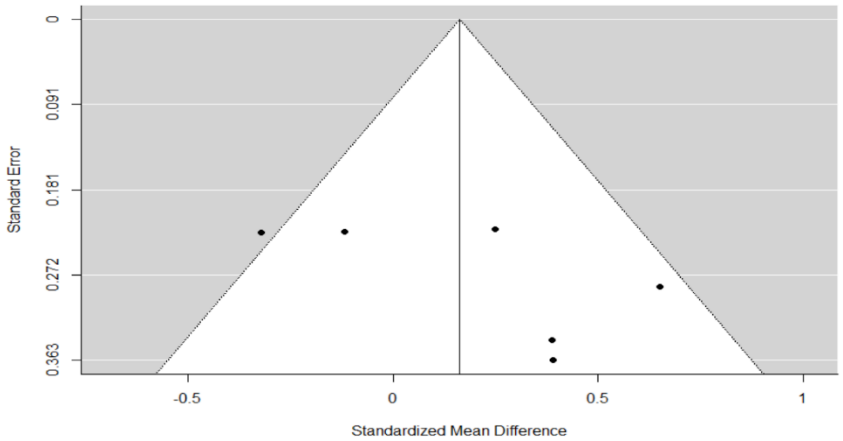


plot 4; influence plot for the studies on the mean pitch model. One can see that there is no clear outliers

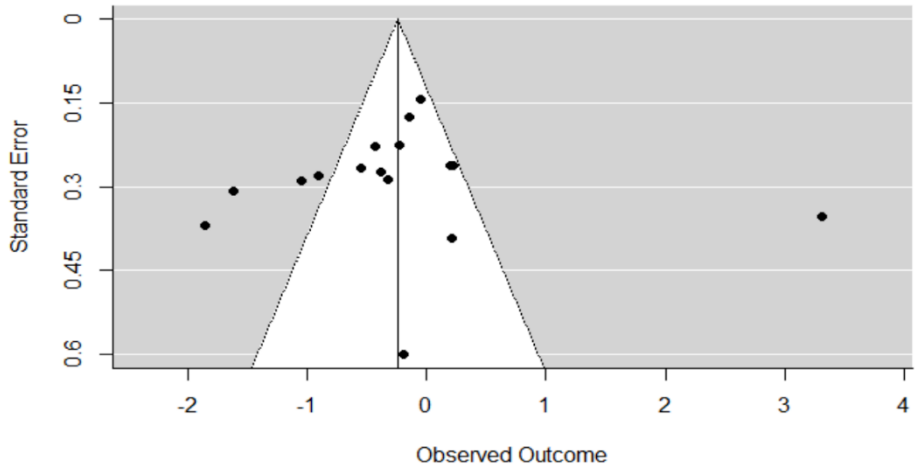


plot 5; influence plot for the studies on the pitch variability model. One can see that there is a clear outlier present (study no. 7)

To investigate whether the literature contains publication bias we created funnel plots for both our models. Looking at the funnel plots below we see that it looks like there seem to be no publication bias present, this can be seen because the funnel plots seem to be more or less symmetrical. however the outlier mentioned earlier is also present here, in the pitch variability model.



plot 6: Funnel plot of the mean pitch model



plot 7: Funnel plot of the pitch variability model.