

One of the regions hindered by schizophrenia is the DLPFC which has been associated with the ability of redirecting attention from one task to another, this is called TS. The literature holds that people affected by schizophrenia do not perform worse than the neurotypical population despite known differences in the DLPFC, pinning it down to some unknown compensation mechanism.

Our dataset was gathered from 175 participants, 125 CTRL and 50 SCHZ. For each we had health related data, a functional connectivity map and a time step dataset composed of all the readings from the test.

The experiment asked participants to identify either the color or the shape of the image, based on a task cue presented prior to the image. On 25% of the trials, participants were asked to switch from identifying color to identifying shape or vice versa. This was a switch trial.

According to the literature

- SCHZ are slower than CTRL but have comparable performance in TS
- Brain activity between SCHZ and CTRL differ in specific region activity.

What we want you to take away from our work is that there isn't any difference in brain region activation, and that neurodiverse people don't seem to be negatively affected by task switching.

Let's break it down:

Initial observations were pretty on the line, SCHZ had overall slower reaction times (fig 3) despite being screened as more impulsive (fig 4). And though age and BMI both had an increasing effect (fig5) on the reaction time we had to discard these factors as they were few and not controllable.

As we dug deeper, we started seeing unexpected results.

As we measured the costs related to switching and answering correctly, measured as the difference between the mean reaction time in the conditions, we can observe two early results. First, we see that switching doesn't need any additional cognitive effort; Second, SCHZ and CTRL apparently have similar speed-accuracy trade-offs (fig 7). And, as we fitted an ANOVA (fig 9) there was no significant interaction between diagnosis and switch.

So, the two groups were seemingly acting the same way, and obtaining different results. How? Why?

Let's start with the reaction time, information taken on any same single participant isn't going to be independent, and in fact as we grouped for subjects, we saw a high PVRE, suggesting that the intrinsic variability between participants could explain much of what we see (fig 10 b). On the side, we noticed this information to be independent of diagnosis (fig 10 a).

Moving on to accuracy, we found out that indeed the general accuracy, intended as correct answers over the total trials, is lower for SCHZ than for CTRL, but this doesn't seem to be related to the switching, indeed when looking at the switch accuracy rate, measured as 1-errors on switch over total errors, we see that CTRL tend to make more mistakes on switch trials compared to the neurodiverse people who didn't seem to be bothered as much (fig 11).

So, we were seeing different results between SCHZ and CTRL, but a lot of variability was given by intrinsic differences between participants, and switching, the thing we were testing for, didn't seem to affect our neurodivergent population, there was still one piece of the puzzle missing.

The brain activity. We started by following the canonical view of the brain, aggregating the 36000 nodes into the 83 canonical regions of the Hammers brain atlas, and analyzed the first three PCs.

We interpreted the opposite sign of the scores either as a competition or as a delay between regions, depending on if these worked to a same goal or not.

These showed that there wasn't any singular region that could explain the difference between groups, and that the regional brain activity between populations was similar.

In fact, they highlighted the brain's average activation levels (fig 12), the prediction mechanism (fig 13) and the dopamine regulation circuit (fig 14). This is interesting because SCHZ have an unbalanced or ineffective dopamine production.

CONCLUSIONS

SCHZ exhibit a higher reaction time and lower accuracy rate than CTRL, but both results seem to be independent of task switching. It doesn't seem necessary to introduce a compensatory mechanism to explain the results of SCHZ, rather task switching doesn't seem to influence them in a specific way. With comparable speed-accuracy trade-offs with respect to the CTRL, the general difficulty of SCHZ is maintaining and implementing a task-set, as SCHZ retain less information and cognitive configuration across tasks. Basically, rendering each trial independent from the previous one.

Our PCA showed no difference in regional brain activation between the two populations, suggesting that the cognitive difference between the two groups is to be sought in the complex interaction between brain networks rather than local regions. Which could also help to explain the high variability across participants highlighted by our LMM, showing that differing performances cannot be attributed to diagnosis alone.