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INTRODUCTION

Multistable phenomena reflect a peculiar behavior of our sensory systems when presented with an unchanging ambiguous stimulus: when this happens, perceptual oscillations between (at least two) different interpretations of that unchanging image occur spontaneously, revealing how the brain gives rise to the subjective phenomenological state we call *percept*. Perceptual alternations between 2 percepts is referred to as **bistable perception**; the oscillations have been shown to reflect the dynamics of the brain's inferential process [1], therefore suggesting that individual differences in perceptual dynamics may be reflected in dynamics of spontaneous neural activities [2] which, in turn, would explain internal states and specific functional organization at the basis of individual differences. Amongst executive functions (which have already been found to be associated with visual processing of bistable phenomena both at local and large scales [2]), cognitive flexibility shares the "switching" feature with bistability, and the ability to momentarily inhibit irrelevant sensory information and change the rule accordingly. In particular, a link has been proposed between individual's perceptual flexibility and cognitive flexibility [3], but not in other cognitive inhibition's functions [4]. On the other hand, also individual's psychological characteristics, such as personality traits [5], anxiety [6] and other conditions have been reported to correlate with temporal dynamics of perceptual alternations; in the past, impulsiveness has not been related with bistable perception [7], but there are no recent studies considering the sub-dimensions of attentional, motor and no-planning impulsiveness proposed by Barratt and colleagues [8].

Our **objective** in this preliminary study, is to evaluate if spontaneous and voluntary alternations in the Necker Cube (durations and switching rates) correlate with cognitive flexibility and other psychological traits and states at the basis of individual differences, and in which direction.

METHODS

Using the online experimental platform "Psytoolkit", cognitive tests have been remotely administered counterbalanced and interleaved with questionnaires (hosted in "QuestionPro" platform) to N=11 subjects (Female=5; mean age: 32,1) during approximately 2 hours with breaks to allow subjects to rest from visual fatigue.

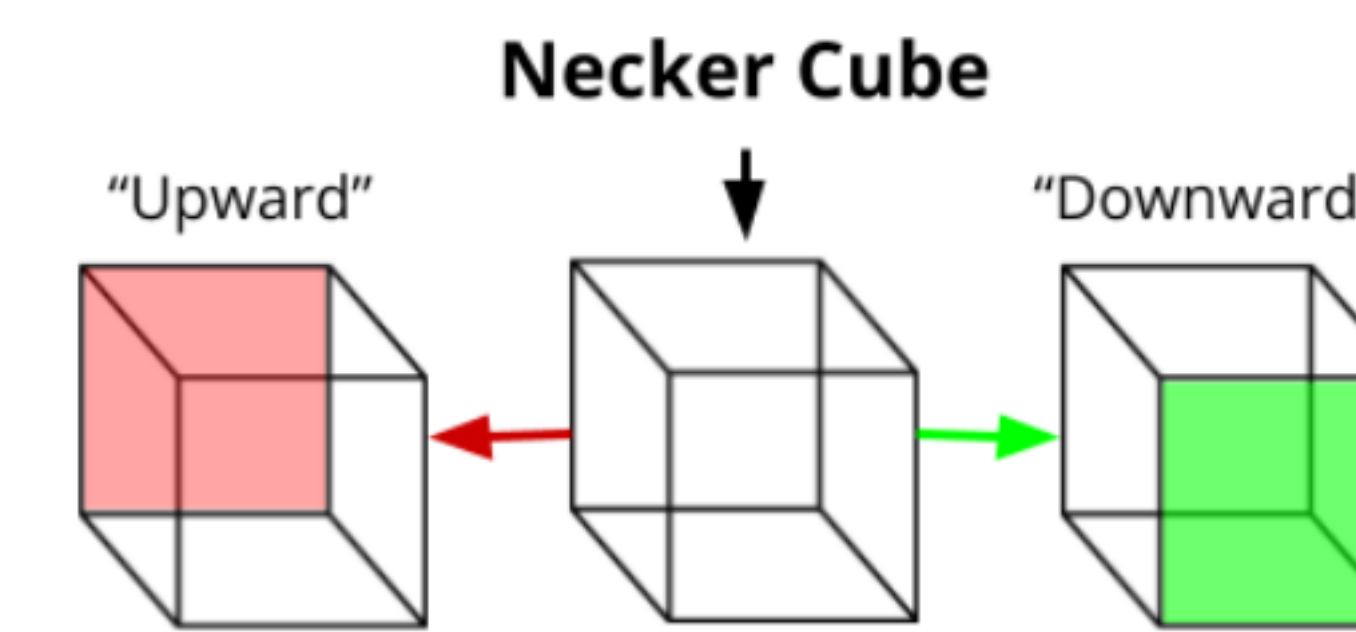


Figure 1. Necker Cube and its different possible percepts. In literature, it has been reported a general preference for the "View-from-above" perspective ("Downward") over the "View-from-below" one ("Upward") [9].

Cognitive Tests:

Necker Cube
Task Switching Task (TST; letters and numbers)
Task Switching Shapes (TSS; cued)

Questionnaires:

CFT (Cognitive Flexibility Test) Argentinian version
Edinburgh Handedness Test



Psytoolkit [10]

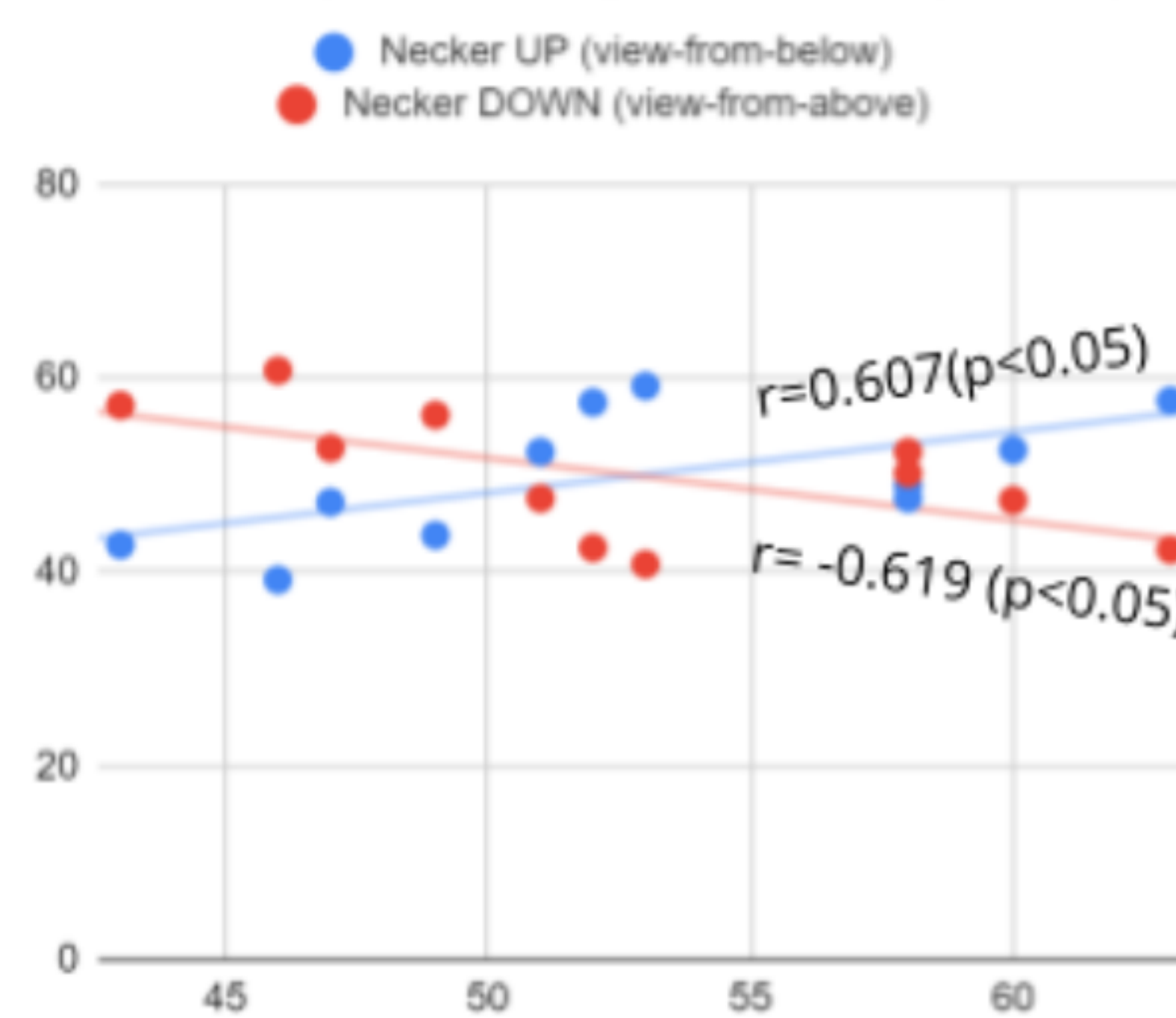
Necker Cube (interleaved) 4 blocks:

- 2 **spontaneous** blocks (3 mins each)
- 2 **voluntary** blocks (3 mins each): 1 NeckerUP and 1 NeckerDOWN (counterbalanced)

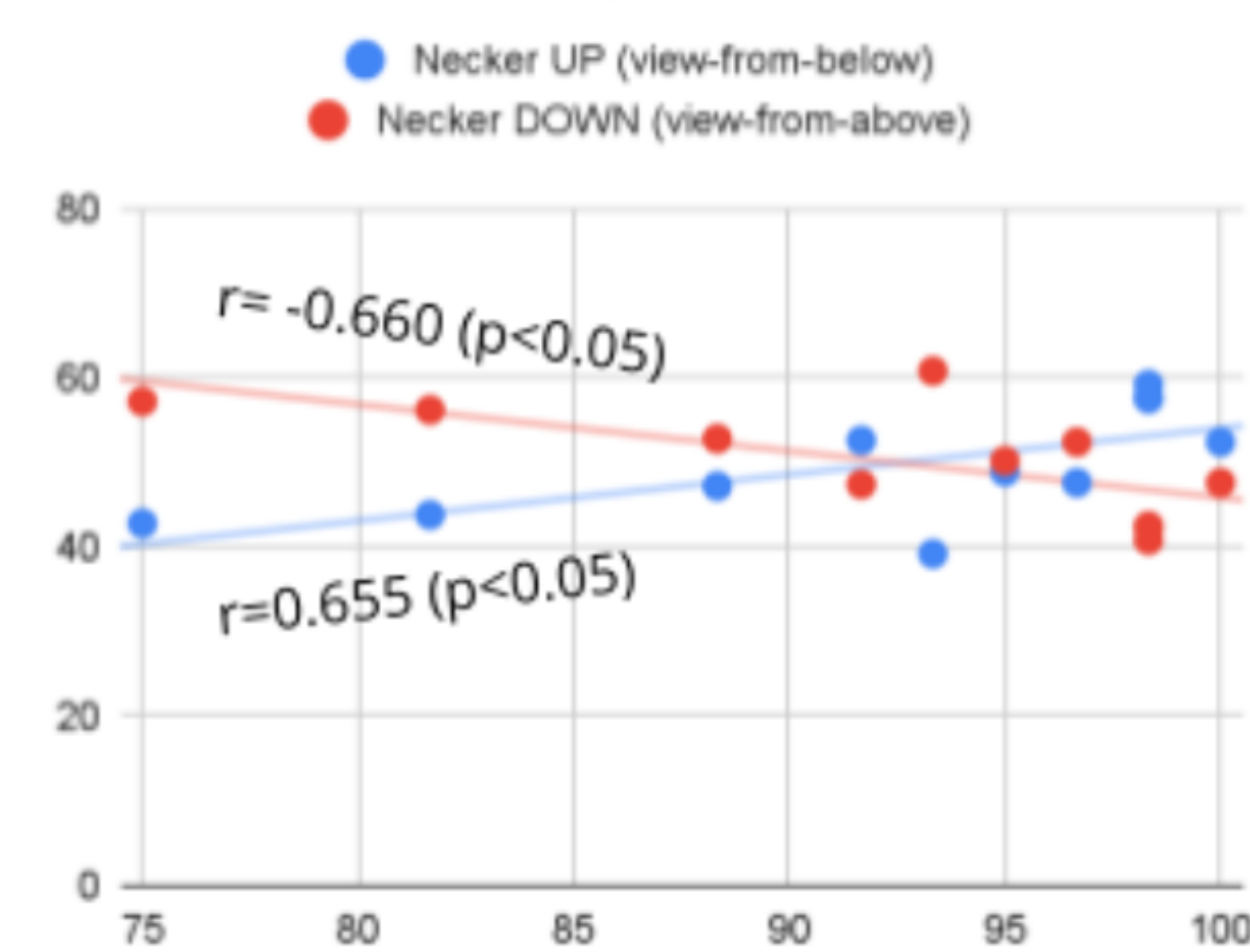
Cognitive tests interleaved and counterbalanced by subject and by sex with Questionnaires

RESULTS

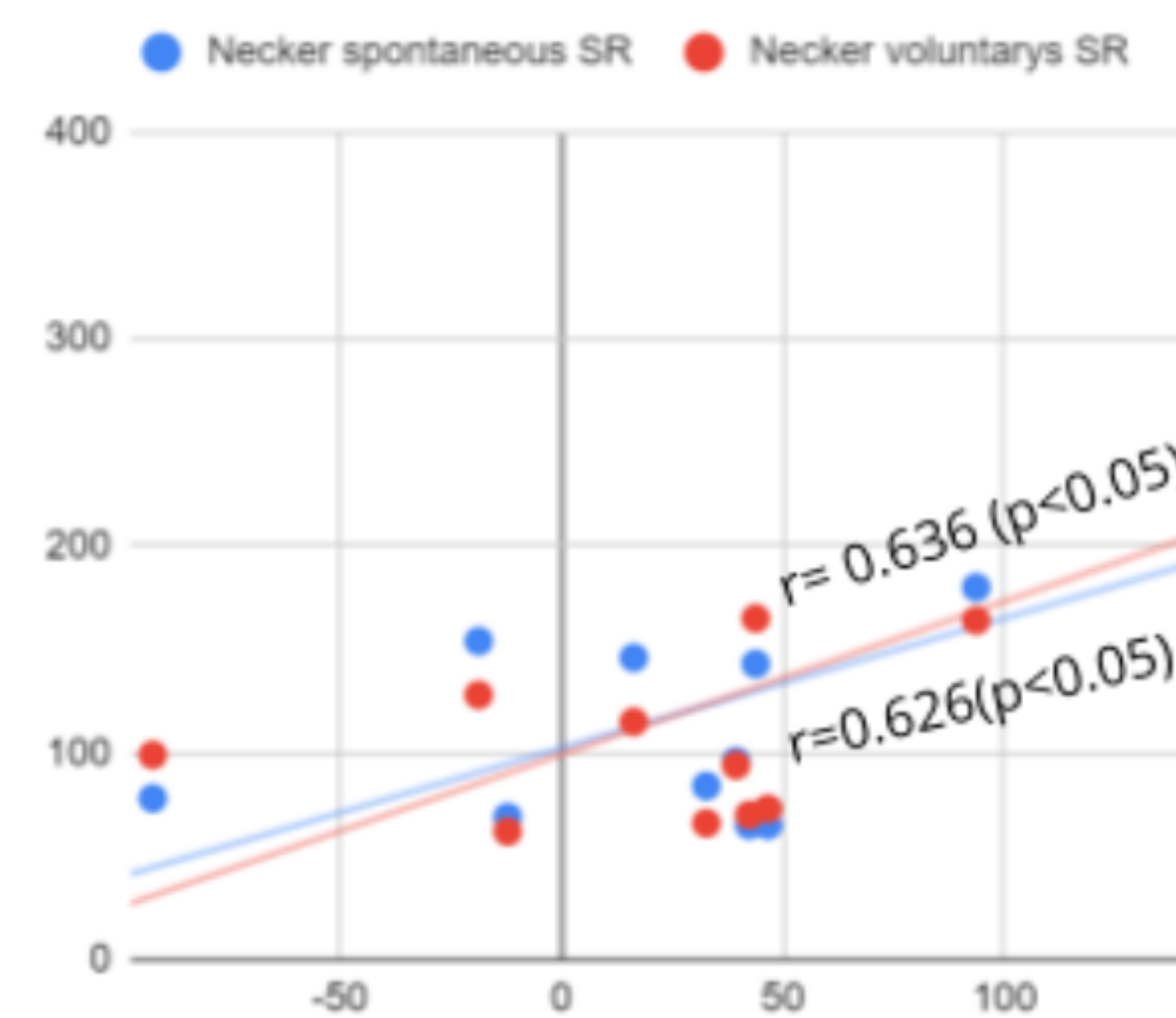
CFT and percentage of each percept



Cued TST accuracy and percentage of each percept



Necker SRs and Simon Test (Cost)



Through Pearson's correlations it has been obtained that Cognitive Flexibility Task (CFT) and the percentage of time spent seeing one or the other percept are significantly correlated: **Necker UP** is positively correlated with CFT's scores ($r = 0.607$; $p < .05$), while **Necker DOWN** is negatively correlated with CFT's scores ($r = -0.619$; $p < .05$).

Also, the percentage of dominances of each percept are significantly correlated with Cued Task Switching Task Accuracy: **Necker UP** is positively correlated with TST accuracy ($r = 0.655$; $p < .05$), while **Necker DOWN** is negatively correlated with TST accuracy ($r = -0.660$; $p < .05$).

Necker's spontaneous switching rates (SRs) are both positively correlated with Simon Task's Inhibition Cost: **Spontaneous** ($r = 0.626$; $p < .05$) and **Voluntary** ($r = 0.636$; $p < .05$).

Other correlations are present amongst the different tests, but they're not related to the objective of this preliminary study.

DISCUSSION AND CONCLUSIONS

The first results of the preliminary study analyzing $n=11$ of a total of $N=26$ subjects seem to highlight a tendency of the two possible percepts' durations to be associated with Cognitive Flexibility. Accuracy in cued TST grows with longer durations for the Necker UP view, while the opposite happens for the "view-from-above" perspective. In the same direction, the higher the perceived Cognitive Flexibility (as scored in the CFT), the most time participants spent seeing the unpreferred view-from-below perspective (Necker UP); the opposite situation we can observe for the view-from-above: when Cognitive Flexibility is higher, the preferred view (Necker DOWN) can be changed for the unusual one, spending less time perceiving it. These findings might reflect a perceptual disposition to flexibility, as opposite to rigidity, considering different and unusual perspectives. The finding that Simon test inhibition Cost results to be significantly correlated with Switching Rates (SRs), might indicate that subjects needing more effort to inhibit incongruent responses are the ones producing more switches between the percepts, reflecting higher perceptual flexibility's cost.

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