

STA490Y1Y – 2019-20

Fall term project

Does auditory distraction affect cognitive flexibility?

Note: Decisions made as a class on September 12 are in blue.

Data must be submitted using the data collection tool (see page 2) by September 17th, at 11:59PM

Cognitive flexibility is the ability of the brain to shift between thinking about different concepts or between different tasks (Braem and Egner, 2018). Previous research has suggested that cognitive flexibility may be related to creative problem-solving (DeHaan, 2009), recall and retention (Taconnat et al, 2009), and advanced knowledge acquisition (Spiro et al, 2012). It has been hypothesized that auditory distraction might have an effect on cognitive flexibility.

For this project, you will:

- (i) make some design decisions (as a class) about the data you will collect to investigate the question of interest,
- (ii) collect data on yourselves,
- (iii) analyse these data to investigate the question of interest (individually), and
- (iv) summarize your findings in a report, written for a non-statistician collaborator (individually).

The *Stroop Effect* captures the increased difficulty, in accuracy and time taken, for subjects to correctly identify the colour of text when the word does not correspond to the colour. (See https://en.wikipedia.org/wiki/Stroop_effect.) A test based on this effect has been used to measure the onset of encephalopathy in patients with liver disease, and an app was developed to carry out this test (Bajaj et al., 2013). The EncephalApp Stroop Test app (app available on Google Play and the Apple App store) computes measurements of cognitive flexibility, psychomotor speed, and accuracy. You can learn more about the app at <http://www.encephalapp.com>.

The app operates on two settings. When Stroop is off, users must identify the colour (in text) of the displayed pound signs. The goal is to do this correctly as rapidly as possible. When Stroop is on, users must identify the colour the displayed word is written in, where the word is another colour. Users complete two practice runs with Stroop Off, then must complete 5 correct runs in the Stroop Off state, and then repeat this in the Stroop On state. Each “run” has 10 stimuli, and a mistake stops the run.

The app provides the following measures. For each, a lower value indicates better performance.

- OffTime: Time required to complete 5 correct runs in the “off” state (a measure of psychomotor speed)
- OnTime: Time required to complete 5 correct runs in the “on” state (a measure of both psychomotor speed and cognitive flexibility)
- Total # of runs Stroop Off: Number of trials required to get 5 correct runs in “off” state (a measure of accuracy)
- Total # of runs Stroop On: Number of trials required to get 5 correct runs in “on” state (a measure of accuracy and flexibility)
- OffTime + OnTime: Sum of OffTime and OnTime (a composite measure of psychomotor speed)
- OnTime minus OffTime: Difference between OnTime and OffTime (an isolated measure of cognitive flexibility)

Data collection:

Tool to measure cognitive flexibility:

EncephalApp Stroop Test (available on Google Play and Apple App store)

Data collection instructions:

- We will collect data on the students enrolled in STA490 in 2019-20 (only).
- Use the English language version of the app.
- Collect data on yourself using the app and the levels of auditory distraction when it is convenient to you. You can do this over multiple days, or all at once. You will enter all of your data in the data collection tool only once, after you have collected data under all three auditory distraction levels.
- For the quiet condition, find a spot where the noise conditions are similar to writing an exam.
- Wear headphones.
- Use the same headphones and use the app on the same device for each level of auditory distraction.
- Use the default settings for the app. The only setting you should change (under the setting wheel) is “Submit Email” which you can change to your email address if you would like to email your results to yourself. Note that you do not need to email the results to yourself, because they will be saved automatically in the App (under Test Results, on the home page of the App)
- The app will ask you to input something for Subject ID, Study Name, and Years of Schooling. You can enter anything here. We won’t be using them.
- Before beginning, randomly choose the order of the levels of auditory distraction that you will experience when you perform the Stroop test.
- For the levels of auditory distraction, use the YouTube links below. If there are advertisements that will play before the music starts, make sure to skip ads before starting the Stroop test. Play the YouTube videos on a different device than the device you are using for the Stroop test app.
- Enter your data at this link. The link to this data collection tool is also on Quercus. You will need to log on with your UTORID to use the data collection tool. Your instructors will see your name/email when you submit your results, but these will be removed before the data are shared with the class.

Levels of auditory distraction:

1. Quiet
2. Music with lyrics (Ed Sheeran, Shape of You)
3. Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)

Factors to control:

The following will be the same for everyone:

- use of headphones
- particular music used for the levels of auditory distraction

Variables to collect:

- Type of headphones used (over-ear or in-ear / noise-cancelling or not noise-cancelling)
- Order in which the three levels of auditory distraction were used
- Number of years you have studied at an English language institution (including 2019-20)
- Whether or not you play video games
- Hours of sleep the night before (for each level of auditory distraction)
- Time of day (for each level of auditory distraction)
- Whether or not you are colour-blind
- Type of device used for the Stroop test app

References:

- Bajaj JS, Thacker LR, Herman DM, et al. (2013). The Stroop Smartphone Application is a Short and Valid Method to Screen for Minimal Hepatic Encephalopathy. *Hepatology* **58**(1), 1122-1132.
- Braem, Senne, and Tobias Egner. (2018) Getting a grip on cognitive flexibility. *Current directions in psychological science* **27**(6): 470-476.
- DeHaan, R. L. (2009). Teaching creativity and inventive problem solving in science. *CBE—Life Sciences Education* **8**(3), 172-181.
- Taconnat, L., Raz, N., Toczé, C., Bouazzaoui, B., Sauzéon, H., Fay, S., and Isingrini, M. (2009). Ageing and organisation strategies in free recall: The role of cognitive flexibility. *European Journal of Cognitive Psychology*, **21**(2-3), 347-365.