U-REAP Report

The Relationship Between Cognitive Decline and Anxiety in Older Adults

Aina Elina Roenningen

Supervisor: Dr. Claudia Gonzalez

Thompson Rivers University, Department of Psychology

Summer, 2020

Abstract

For my UREAP, I investigated the relationship between anxiety and cognitive decline in older adults, with assistance from my supervisor Dr. Claudia Gonzalez. Due to the outbreak of COVID-19 in March, we had to make some changes to the initial research plan so that the project adhered to the COVID-19 guidelines. The changes included moving all experimental procedures online in order to ensure social distancing. The first weeks consisted of finding an online platform that could be used for experimental testing. After reviewing and testing different platforms, we chose the online platform *Gorilla* (https://gorilla.sc/). Gorilla is an online platform that allows researchers to design experiments and collect behavioral data remotely and in a secure environment. After learning how to use Gorilla I designed two different reaction time tasks that can be used to collect behavioral responses from potential participants. I also designed and built a Demographic's questionnaire and implemented anxiety and mood questionnaires such as the DASS – and STAI questionnaires, which we originally intended to use face to face. I found the platform easy to use, intuitive and engaging and it provided me with the rare opportunity of designing my own tasks. Building the experimental behavioral tasks required trouble shooting, guidance from my supervisor and other researchers from the Gorilla online community and practice. During this time, I also completed several literature reviews on the relationship between anxiety and cognitive decline in older adults, which would all link into a larger literature review. The reviews where separated into smaller sections so that I could practice and receive more frequent feedback on my writing skills. This is something that I am interested in learning since it will prove useful for my future plans as a graduate student. Linking the reviews also provided a deeper understanding of the relationship between cognitive

decline and anxiety in older adults. In addition, my other goal was to get familiar with research methods used by other researchers to examine the links between anxiety and cognition. I therefore implemented this knowledge into designing my experiment.

Background

In older adults, cognitive deficits, such as poor working memory, often co-occurs with anxiety (Mella et al., 2018). Anxiety can be defined as an aversive motivational and emotional state that occurs when the individual perceives a situation as highly threatening (Eysenck et al., 2007). Furthermore, anxiety includes the two components "worry" and "arousal." "Arousal" refers to somatic tension and physiological hyperarousal and is characterized by shortness of breath, trembling, shaking and lightheadedness, whereas "worry" refers to cognitive anxiety and is characterized by verbal rumination of potential negative consequences of future events (e.g., Watson et al., 1995; Lowe & Reynolds, 2000; Mohlman et al., 2017). These two factors can be measured separately and have been shown to differentially influence performance (Eysenck 1982; Eysenck, 2007).

The development of anxiety symptoms that lead to a clinical diagnosis and its link with cognitive decline have not yet been established. However, anxiety in older adults has been linked with cognitive decline in that lower cognitive functioning correlates with increased anxiety (Petkus et al., 2017; Mella et al., 2018). Some researchers also show that heightened anxiety levels might lead to accelerated age-related cognitive decline (Petkus et al., 2016; Sinoff and Werner, 2003; John et al., 2018). Specifically, researchers have found that older adults exhibiting high anxiety including worry and arousal demonstrate reduced cognitive functioning in executive processes, which involve attention, inhibition, shifting and working memory (Mella

et al., 2018; Petkus et al., 2017; Eysenck et al., 2007; Schoen & Holtzer, 2017; Edwards et al., 2015; Beaudreau & O'hara, 2009; Yochim et al., 2013; Bierman et al., 2008). Furthermore, Schoen and Holtzer (2017) reported that high cognitive anxiety (i.e. worry) correlated with low cognitive flexibility, and that somatic anxiety led to slower performance overall in older individuals. In contrast, Mella et al. (2018) found that in a group of older adults, cognitive flexibility was impaired by elevated cognitive anxiety (worry) levels but not somatic anxiety. This is in accordance with the Attentional Control Theory (ACT) which suggests that worry is the anxiety component that has strongest effect on cognitive functions, task performance and efficiency (Eysenck et al., 2007). Worry might interfere with attentional resources thus depleting the resources that could be allocated to the task. These findings, though contradictory, demonstrate that worry and arousal have different effects on performance in old age. Importantly, they also show a link between cognitive decline and higher anxiety vulnerability.

As we can see, the problem lies in the bidirectional effects of both in that anxiety affects cognitive performance but lower cognitive abilities may also lead to anxiety. Moreover, the negative effects of anxiety on cognitive function is of clinical importance because standard cognitive assessments that are used to identify cognitive deficits in older adults might induce anxiety, thus leading to a possible misdiagnosis (Mella et al., 2018). Therefore, understanding the relationship between cognition and anxiety in older adults can help reduce the likelihood of a misdiagnosis as well as improve the identification of normal cognitive aging from pathological processes associated with dementia and Alzheimer's disease.

Experiment design

Reading the different articles on executive processes and anxiety in older adults provided me with the knowledge I needed to design and construct the experiment. I focused on inhibitory processes specifically, and made two tasks that measure such behavior. One of those tasks is the Posner Cueing task, which is a neuropsychological test that often is used to measure attention control processes. An initial fixation is shown in the center of the screen. To the right and left of this cross, there are 2 boxes which mark the location of where a stimulus will appear during the trials. Before the stimulus is presented, a cue (the box is filled in a grey colour) will appear on the screen to indicate where the subsequent stimulus will appear next. There is a brief interval between the cue presentation and the following stimulus. When the stimulus appears, participants are required to respond as quickly as possible, for example by pressing keys on the keyboard (F for right and J for left). The Posner Cueing task includes both valid and invalid trials. In valid trials, the stimulus is presented in the box where the cue appeared. In invalid trials, the stimulus appears in the opposite box of where the cue was presented and will measure the participant's reaction times when his/her expectation is violated. Participants then have to inhibit a very salient response and then re-direct their attention to the opposite side.

Posner Cueing task that I designed has four different locations on the screen in order to increase task difficulty and increase working memory components. This is because anxiety effects are more pronounces in more complex tasks than simple ones. I made two different conditions in Gorilla. One of the conditions involves a neutral flower stimulus, whereas the other condition involves a spider as a threat stimulus. The aim to measure if threat increases error rates during invalid trials. If participants have higher anxiety, we hypothesize that they will

show more errors in inhibiting this threat stimulus, compared to someone with low anxiety. The participants will press the F key when the stimulus appears in the top or left box, and the J key when the stimulus appears in the right or bottom box (see Figure 1).

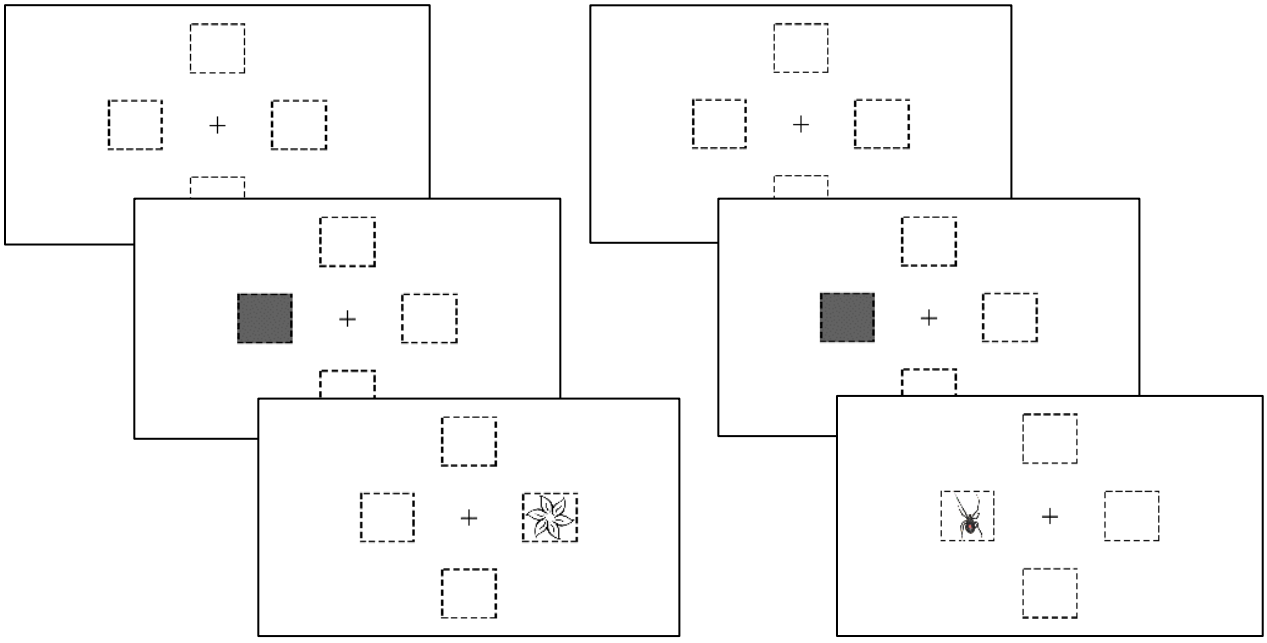

Figure 1. Example of an invalid trial (non-threat, left) and an example of valid trial (threat, right) in a Posner Cueing task.

In addition to the Posner cueing task, I also designed a Go/No-Go task. The Go/No-Go task also measures inhibitory responses. During the Go-trials, participants will press a key when a specific stimulus shows up, whereas during the No-Go trials, participants are required not to press any key. The participants then need to pair go and no go according to the stimulus (see Figure 2). In my Go/No-Go design, I implemented a threat and non-threat condition like I did in the Posner cueing task. Participants are to press the “spacebar” only in Go trials and do nothing in No-Go trials.

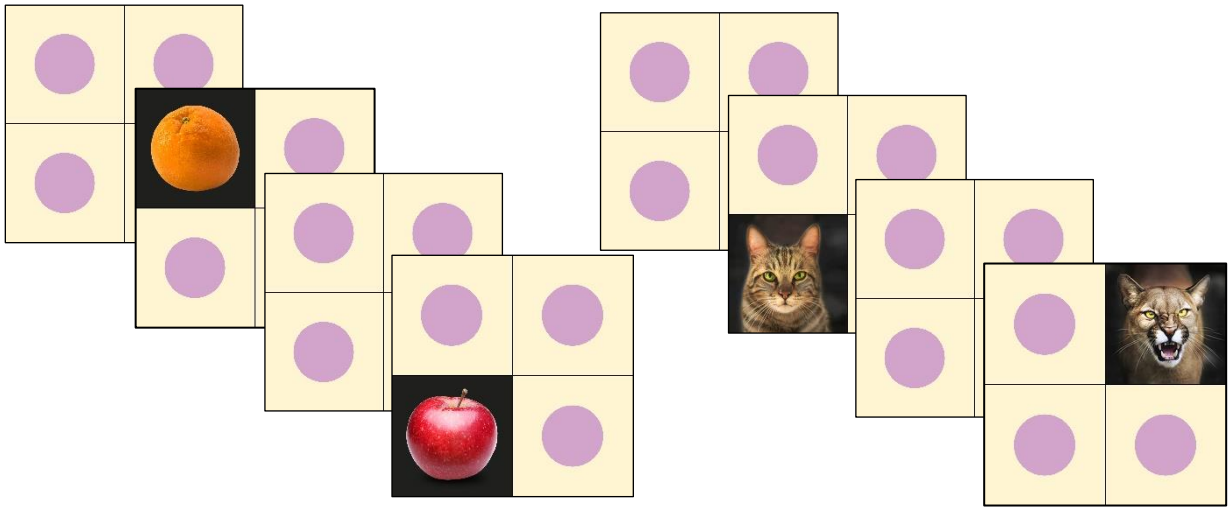

Figure 2. Go/No-Go trials (non-threat, left). Red apple indicates "No-Go", whereas orange indicates "Go." In the Go/No-Go trials to the right (threat), cougar indicates "No-Go," whereas cat indicates "Go."

In addition to the two tasks, I designed different questionnaires that will be used in the experiment. One of the questionnaires is a demographic-questionnaire that will collect demographic and medical data about each participant. The questionnaire section about their health status includes questions such as "Have you ever been diagnosed with a neurological condition?" and "Do you have any vision problems that would impair your ability to identify colour or items?" These questions, among others, will be used to control for eligibility. In addition, different health conditions may influence our study results, and therefore, it is important to rule out different data that might lead to confounds. I also implemented the Stait-Trait Anxiety Inventory in Gorilla. The Stait-Trait Anxiety Inventory includes statements such as "I feel calm", "I am tense" and "I feel at ease", among other statements. The participants will be asked to rate themselves on these questions on a four-point scale with the options *1 - Not at all, 2 – Somewhat, 3 - Moderately so, 4 - Very much so.* The third questionnaire that I implemented in the online platform was the Depression Anxiety Stress Scales (DASS). The DASS

includes questions such as *1. I couldn't seem to experience any positive feeling at all* and *2. I found it difficult to work up the initiative to do things,* among other questions. Similarly to the STAI-questionnaire, participants will be asked to rate themselves on a four-point scale with the options *0 – Did not apply to me at all, 1 – Applied to me to some degree or some of the time, 2 – Applied to me to a considerable degree or a good part of time, 3 – Applied to me very much or most of the time.* In the DASS, we have only included the questions that measure participants' mood (Depression) since the STAI covers anxiety levels. In addition to these questionnaires, I designed a generic consent. The study has also been approved by the TRU ethics committee.

Future directions

I found that my UREAP experience was a valuable one and allowed me to get familiar with research methods that I had not implemented before. I gained experience in conducting thorough literature reviews with the aim of implementation which is not something I would so during a regular course. I also gained expertise in experiment design in an online platform and implemented problem solving skills everyday to make sure that the tasks worked. These platforms make it easy for researchers and clinicians to measure cognitive function and I believe the skills I gained will serve me in my future career plans. We will be continuing the research on the relationship between anxiety and cognitive decline in older adults. I also secured a place into the I into the Honour's program, which runs from fall 2020 until the winter 2021, with Dr. Gonzalez as my supervisor. I am looking forward to continue working on the experiment design and the data collection. Doing UREAP this summer has been a wonderful experience and I am very pleased to be a part of this research.

References

Beaudreau, S. A., & O'hara, R. (2009, June). The Association of Anxiety and Depressive Symptoms with Cognitive Performance in Community-Dwelling Older Adults. *Psychol Aging*, pp. 507-512. Retrieved from doi:10.1037/a0016035.

Bierman, E. J., Comijs, H. C., Rijmen, F., Jonker, C., & Beekman, A. T. F. (2008, July). Anxiety Symptoms and Cognitive Performance in Later Life: Results From the Longitudinal Aging Study Amsterdam. *Aging and Mental Health*, pp. 517-523. Retrieved from DOI: 10.1080/13607860802224276.

Edwards, E. J., Edwards, M. S., & Lyvers, M. (2015). Cognitive Trait Anxiety, Situational Stress, and Mental Effort Predict Shifting Efficiency: Implications for Attentional Control Theory. *Emotion*, pp. 350-359. Retrieved from http://dx.doi.org/10.1037/emo0000051.

Eysenck, M. W. (1982). *Attention and arousal: Cognition and performance.* Berlin: Springer-Verlag.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and Cognitive Performance: Attentional Control Theory. *Emotion*, pp. 236-353. Retrieved from DOI: 10.1037/1528-3542.7.2.336.

Gorilla Experiment Builder. (n.d.). *Gorilla Experiment Builder*. Retrieved from Gorilla TM: https://gorilla.sc/

John, A., Patel, U., Rusted, J., & Richards, M. (2018, April). Affective problems and decline in cognitive state in older adults: a systematic review and meta-analysis. *Psychological Medicine, 49*, pp. 353-365. Retrieved from DOI: https://doi.org/10.1017/S0033291718001137.

Lowe, P. A., & Reynolds, C. R. (2000). Exploratory Analyses of the Latent Structure of Anxiety Amonf Older Adults. *Educational and Psychological Measurement*, pp. 100-116. Retrieved from DOI: 10.1177/0013164400601007.

Mella, N., Vallet, F., Beaudoin, M., Fagot, D., Baeriswyl, M., Ballhausen, N., Métral, G., Sauter, J., Ihle, A., Gabriel, R., Oris, M., Kliegel, M., & Desrichard, O. (2018). Distinct Effects of Cognitive Versus Somatic Anxiety on Cognitive Performance in Old Age: the Role of Working Memory Capacity. *Aging and Mental Health*, pp. 1-8. Retrieved from DOI: 10.1080/13607863.2018.1548566.

Mohlman, J., Eldreth, D. A., Price, R. B., Staples, A. M., & Hanson, C. (2017). Prefrontal-limbic connectivity during worry in older adults with generalized anxiety disorder. *Aging and Mental Health*, pp. 426-438. Retrieved from http://dx.doi.org/10.1080/13607863.2015.1109058.

Petkus, A. J., Reynolds, C. A., Wetherell, J. L., Kremen, W. S., Pedersen, N. L. & Gatz, M. (2016). Anxiety is Associated with increased Risk of Dementia in Older Swedish Twins. *Alzheimer and Dementia, 12*, pp. 399-406. Retrieved from http://dx.doi.org/10.1016/j.jalz.2015.09.008.

Petkus, A. J., Reynolds, C. A., Wetherell, J. L., & Kremen, W. S. (2017). Temporal Dynamics of Cognitive Performance and Anxiety Across Older Adulthood. *Psychology and Aging* , pp. 178-292. Retrieved from http://dx.doi.org/10.1037/pag0000164.Schoen, C. B., & Holtzer, R. (2017, September). Differential Relationships of Somatic and Cognitive Anxiety with Measures of Processing Speed in Older Adults. *Neuropsychol Dev Cogn B*

Aging Neuropsychol Cogn, 24(5), pp. 481-495. Retrieved from doi: 10.1080/13825585.2016.1226247.

Schoen, C. B., & Holtzer, R. (2017, September). Differential Relationships of Somatic and Cognitive Anxiety with Measures of Processing Speed in Older Adults. *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn, 24(5)*, pp. 481-495. Retrieved from doi: 10.1080/13825585.2016.1226247.

Sinoff, G., & Werner, P. (2003). Anxiety Disorder and Accompanying Subjective Memory Loss in the Elderly as a Predictor of Future Cognitive Decline. *Int J Geriatr Psychiatry* , pp. 951-959. Retrieved from DOI: 10.1002/gps.1004.

Watson, D., Weber, K., Assenheimer, J. S., Clark, L. A., Strauss, M. E., & McCormick, R. A. (1995, February). Testing a Tripartite Model: I. Evaluating the Convergent and Discriminant Validity of Anxiety and Depression Symptom Scales. *J. Abnorm. Psychol., 104*(1), pp. 3-14. Retrieved from doi: 10.1037//0021-843x.104.1.3.

Yochim, B. P., Mueller, A. E., & Segal, D. L. (2013). Late Life Anxiety is Associated with Decreased Memory and Executive Functioning in Community Dwelling Older Adults. *Journal of Anxiety Disorders, 27*(6), pp. 567-575. Retrieved from doi: 10.1016/j.janxdis.2012.10.010.