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Stroop Task Uniformity in the Kronos Early Estrogen Prevention Cognitive and Affective Study (KEEPS C/A)

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Background/ Significance: The American Psychological Association has recommended that uniformity between paper-and-pencil and computer-based versions of a test should not be assumed. Instead, uniformity should be the subject of investigation in every case. Thus, testing the equivalence of paper-and-pencil questionnaires in comparison to computer-based cognitive assessments is warranted.

The Golden version of the paper and pencil Stroop Test is composed of three sections – color, word and colored-word. The score for each portion is the number of items correctly named in 45 seconds, as well as the number of errors and self-corrections.

The computerized version of the Stroop Test was developed by Eef Hogervorst, PhD and Stephan Bandelow, PhD. The test was included in order to capture reaction time data, sensitive to subtle changes in attention and concentration. Like the paper and pencil Stroop Test, the computerized version is a test designed to assess selective attention. However, unlike the Golden version, the computerized version is comprised of two parts, instead of three. The first test has 15 stimuli (reading colors) the second (with interference) has 40 stimuli. The test items initially are easy, but progressively become more difficult. The trial is discontinued once the subject makes a requisite number of consecutive errors, so as to prevent subject fatigue and demoralization. The computerized Stroop program has been used extensively by Dr. Hogervorst in estrogen and estrogen-analog research.

Previous research suggests cognitive benefits on the Stroop Interference Test of selective attention both with higher endogenous estrogen levels, as well as with hormone therapy administration. For instance, women tested during the menstrual phase of their 28-day cycle (those women with lower endogenous estrogen levels); exhibit greater Stroop effects when compared to women tested during the luteal phase. Of note, research suggests that estradiol, not progesterone is the primary cognitive determinant in naturally cycling women. Similarly, the Stroop Color- Word Test is very sensitive to the effects of aging and AD and to a wide variety of interventions such as exercise, caffeine, hormone therapy etc. (Hogervorst, 1998, see pubmed for a complete list of references).

Objectives:

- 1) Systematically evaluate the inter-subject performance correlation between the two versions of the Stroop Interference task.
- 2) Examine the relationship between baseline estradiol (E2) levels and 1) the paper and pencil version of the Stroop Interference task and 2) the computerized version of the Stroop task.



Hypothesis: Based on initial reports, we foresee a relationship between performance on the paper and pencil and computerized versions of the Stroop Interference task. Additionally, we predict a positive correlation between baseline estradiol levels and performance on both Stroop tasks, such that higher levels of estradiol will yield better cognitive performance.

Methods/Analysis Plan: After baseline data cleaning, a basic exploratory analysis using descriptive statistics (means, variances, covariances, and correlations) will be performed. Also, an analysis of the distribution of all variables considered in this proposal will be conducted and transformations to normality will be performed as needed. As age will have to be controlled very carefully, age will be considered a categorical variable for all analyses in 1 year increments.

As an overview, we propose three related analyses. First, product-moment correlations will be computed between scores on the two versions of the Stroop test interference condition. Secondly, we will investigate the relationship between estradiol levels and variables on the two versions of the Stroop using product-moment correlations. Because estradiol levels are not the subject of our primary analyses, the standardization of values will not be undertaken unless there is an unexpected between-site discrepancy. Finally, we will examine the relationship between the two Stroop tests and other measures of attention and executive function such as Trails A and Digit Symbol Tasks. More specific detail on the steps of these analyses is provided below. Correlations attaining a significance at the $p < 0.05$ level will be reported. Analyses will utilize both the Stroop Interference paper-and-pencil and computerized tests and we will correct for multiple comparisons.

First, for the purposes of task validity, we will assess reaction times independently for the Color, Color-Word, and in the case of the paper and pencil test, the word conditions independently. For the principal analyses, reaction time to the Color-Word condition and sensitivity to interference (mean RT Color - Word condition – mean RT Color condition) will be the primary outcome variables. The principle analyses will include the following:

- 1) RT and error rate comparisons between both Stroop tests on the Color and Color-Word conditions.
- 2) Comparison of 'sensitivity to interference' between the 2 Stroop tests.
- 3) Correlational analyses between estradiol levels and RTs for all cognitive variables on both Stroop Tests
- 4) Correlational analyses between estradiol levels and sensitivity to interference on both Stroop Tests

Last, linear multiple regression analyses will be carried out primarily to examine the effects of baseline estradiol levels data on cognitive task performance using age, years of education, socioeconomic status (SES) and ethnicity as covariates in the models. Also, although the computerized Stroop task does not require participants to be computer literate and includes practice trails, a multiple regression will account for any performance variability based on prior computer accessibility and experience.

Pertinent Variables: Cognitive variables: Paper-and-pencil and computerized Stroop Tests, digit symbol and Trails A

Demographic variables: age, education, socioeconomic status (SES) and ethnicity. Baseline MiniMental State Exam Scores

Labs: Estradiol levels