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Diet and the Role It Plays In Cognition

Ryan S. Lavrisa
Georgia Southern University

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By
Ryan Lavrisa

Under the mentorship of *Dr. Virginia Wickline*

ABSTRACT

The Food and Agricultural Organization of the United Nations have calculated the effects of animal agriculture and factory farming to be responsible for generating 14.5-16.5% of global greenhouse gas emissions as well as using 70% of all agricultural land to sustain itself. Plant-based diets such as veganism and vegetarianism have been on the rise as many seek to find diets that mitigate the animal suffering and environmental impact for which animal agriculture is responsible. With the rise of these diets, it is important to understand the cognitive effects adhering to such diets can have on the body and mind, as well as potential risks. Previous studies have shown that adherence to a more plant-based diet can mitigate cholesterol risks, reduce risk for developing dementia related diseases, and increase cognitive performance. The current study aimed to see if there were indeed relationships between the degree of plant-based diet and related health and cognitive outcomes. An online hybrid cross sectional study was conducted with Georgia Southern undergraduate students (N = 224) through Qualtrics and PsyToolkit. The participants took part in the Stroop Task as well as the Deary- Liewald Simple Reaction Time Task to gain insight into their processing speeds as well as their reaction time speeds, respectively. The participants then answered questions related to their diet as well as a cognitive flexibility self-report measure and several health measures. Results found that reports of high cholesterol were significantly greater for those with a lower degree of plant-based diet. Results for other predictions were largely inconclusive, therefore not supporting the hypotheses and would need further study and experimentation to identify causality.

Thesis Mentor: *Dr. Virginia Wickline*

Honors Dean: *Dr. Steven Engel*

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Georgia Southern University

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Simple reaction time (SRT), the least amount of time needed to respond to a stimulus, is one of the most basic measures for processing speed. SRTs date back to being first measured by Francis Galton in the 19th century (Woods et al., 2015). Although technology then was not as accurate as it is today, it still provided the scientific community with a way for measuring reaction times. Fluid intelligence, defined as reasoning ability and the ability to transform, manipulate, and generate information in real time, plays a large role in reaction time. Cognitive flexibility is another term to describe a person's fluid intelligence, as it allows them to be able to adapt their thinking and behavior to real-time changing circumstances or information being presented to them (Diamond, 2013). Cognitive processing speed is a term used to describe the rate at which a person can perceive a cognitive task, or some sort of sensory information that is presented to them, interpret it, and then respond in an appropriate manner (Salthouse, 1996). Many other factors play into people's ability to react quickly, such as athleticism, or even playing a lot of action video games (Dye et al., 2009). Such things have been tested in the scientific community, but the question arises: What else affects the speed at which humans react? Three basic staples exist in everyone's life that they must adhere to in order to live: food, water, and shelter. With many different new diets arising in popularity such as ketogenic diets, plant-based diets, gluten-free diets, low-carbohydrate diets, and carnivore diets, it leads to the question as to how these diets affect myriad processes in the human body. This study's aim is to determine whether varying diets can predict differences in cognitive elements like simple reaction time, cognitive flexibility, and processing speed.

Food Production and Consumption

In the current state of today's agriculture, animal agriculture is responsible for generating 14.5-16.5% of global greenhouse gas emissions, as well as using 70% of all agricultural land (Food and Agricultural Organization of the United Nations, 2018) which, in turn, is the leading cause of much of the biodiversity loss on Earth. Due to these environmental factors, great pressure exists for change in the industry. Given the significant environmental degradation, as well as the 88 billion+ land animals that are bred and slaughtered for food globally each year (Humane Society International, 2022), people switching to a plant-based diet has been seen as a way to significantly suppress the adverse effects of animal agriculture. A plant-based diet consists of only plants, as the name suggests, and indicates that the person following the diet consumes no fish, meat, poultry, dairy, eggs, or anything that is not considered a plant or fungus. Vegan is another term used for someone who does not consume animal products but is more of a philosophical standpoint against the suffering of animals for human benefit. Vegetarianism is a diet consisting of only plants but allows for the consumption of eggs and dairy. In an online poll conducted by the Vegetarian Resource Group in 2019, it was found that 4% of Americans are vegetarian, and 2% are vegan. These new plant-centered diets are experiencing growing popularity. They have been gaining awareness due to documentaries such as *The Game Changers* (Louie Psihoyos, 2018) and *Cowspiracy* (Andersen & Kuhn, 2014), as well as the increase of influencers and celebrities who are switching to a more plant-centered diet. It is important to understand the benefits and as possible detriments of a plant-centered diet for cognitive functioning. More specifically,

it is important to understand if there is a connection between cognitive processing and the way that people eat and fuel their bodies.

Dietary Evolution

Evolutionary development is an important area to observe when looking at why a species lives the way that they do, reproduces, and chooses partners the way that they do, as well as understanding why the diet that a species consumes benefits that species over the span of their evolutionary history. When looking at modern evolution for the human (homosapien sapiens) species, there is a clear evolutionary connection between modern homosapien sapiens and chimpanzees (Britannica, 2022). However, there are vast differences in the modern diet of both creatures. Chimpanzees eat a broad, mostly fruit-based diet (Watts et al., 2011), but environmental factors could lead them to consume more leaves or nuts. The National Cancer Institute (NCI) (2019) recommended fruit intake for humans to range from 1 to 2.5 cups per day. However, in a 2010 Food Intake report by the NCI, it was found that 25% percent of the U.S. population consumes less than half a cup per day, and 75% of the population had intakes below the minimum recommendation for their sex-age group. It was also found that 93% of all children (ages 1-18) consumed fewer vegetables than recommended, and 87% of the total population had a usual intake below the minimum recommendation for vegetables (at least 1 cup per day in the minimum recommendation). The U.S., coincidentally, also has a major obesity problem, with the U.S. obesity prevalence being 41.9% from 2017 - March 2020 (Center for Disease Control and Prevention, 2022) which had risen from 30.5% in 2000. Humans are rare in the animal kingdom in their habit of consuming milk out of infancy on a regular basis (in the case of omnivores and lacto-ovo vegetarians), as well as consuming

high-cholesterol foods and low amounts of fruit and vegetables compared to other species that share common ancestors. With the recent wave of plant-based diets becoming more and more common, not to mention the push for less meat consumption and better treatment for animals, new diets help to raise questions regarding what new diets do to the body, what changes they can make that are either beneficial or detrimental to people's well-being, and if they are more in line with what humans ate in the past.

Benefits of Healthy Eating

A main benefit of a plant-based diet, other than helping reduce the impact of agriculture on the world and its ecosystems, is its positive effects on individuals' health. One main health benefit is that there is no cholesterol consumed. Consumption of cholesterol has been found through a study on over 29,000 adults that each additional 300 mg of dietary cholesterol consumed per day was associated with a significantly higher risk of a CVD (cardiovascular disease) incident (Zhong et al., 2019). Biase et al. (2007), who collected blood samples from 76 male and female individuals, found that a vegetarian diet was associated with significantly lower levels of TG (triglyceride levels), TC (total cholesterol), and LDL (low-density lipoprotein cholesterol levels) as compared to that of the diet of omnivores. Further, the HDL/TC ratio was significantly higher in vegans. Taken together, the research suggests that people whose diets were plant-based had significantly healthier levels of cholesterol, which in turn had a significant correlation with a lower risk of cardiovascular disease.

Body Mass Index and Diet

Obesity, the over-accumulation of fat, has adverse effects on health. The World Health Organization (2016) defines overweight as a Body Mass Index or BMI ≥ 25 and

obesity as a (BMI) ≥ 30. Research done by Wang et al. (2016) based on BMI data found that people who are overweight or obese fall into the lowest quartile of global cognition, intelligence, and immediate logical memory. Medawar et al. (2020) found that on average, the fewer animal products people consume, the lower their BMI. These findings both clearly indicate the physiological functioning risks that develop from outcomes related to frequently eating animals.

Previous Studies on Diet and Cognition

Nutrition has been a widely observed and studied area in the field of science for quite some time, but with the rising interest globally in new diets, new studies have been conducted to investigate possible connections between nutrition and cognitive performance. Three prominent studies are able to shed some of their knowledge when it comes to plant-based diets (such as vegetarianism and veganism) and the Mediterranean diet, which is characterized by high consumption of fruits, vegetables, fish, and olive oil and has shown promise in helping individuals decrease risk for cognitive decline as they age. In a study published by Barberger-Gateau et al. (2013), researchers investigated the cognitive function of individuals following vegetarian diets. The study found that in older adults, a vegetarian diet was associated with better cognitive performance in certain domains such as memory. Another supporting study is by Trepanowski et al. (2018), where a team of researchers examined the cognitive performance of young adults following a vegan diet. The study reported that individuals on a vegan diet demonstrated better executive functioning and processing speed compared to omnivores. This study was unique in that it ran a controlled experiment where participants were monitored on their diets for 6 weeks with strict adherence to either a vegan diet or an omnivore diet.

For the alternative diet which includes fish, the Mediterranean diet, a study conducted by Tangney et al. (2014) found that adherence to a Mediterranean diet was associated with better cognitive performance and a lower risk of cognitive decline in older adults. These studies give support to the current research being conducted, as well as show that there is potential for these plant-based diets to improve cognitive functioning in humans.

The Current Study

Given the previous research, something as simple as the foods that go into the body can cause immediate physiological effects that can either boost people's physical performance or, in turn, decrease it. If one lived in a warzone or were trying to escape predators, how quickly one can react could mean life or death. Having the proper nourishment can fuel people to survival, whereas improper nourishment could, in extreme cases, lead to death. The military does not currently have any MRIs (Meals Ready to Eat) that are plant-based, but they do have meal kits that include cheddar cheese spread and pepperoni pizza cheese-filled crackers (MREinfo, 2021). There have been amendments proposed to the U.S. Congress to accommodate plant-based eaters in the military, but as of now, there have been no big changes made. Veganism is growing as time passes, and the sales of plant-based foods grew three times faster than the overall food sales in 2021 (Kim, 2022), which shows that the general population seems to be becoming increasingly more supportive of plant-based alternatives to meat**.**

In the current study, I will investigate whether there are correlations between reaction time speeds and degree of plant-based diet (a diet high in vegetables, whole grains, and fruits). Specifically, I will determine if the degree of plant-based diet one has is related to reaction times and processing speeds. I hypothesize that a more plant-based

diet will be negatively correlated with reaction time speeds and processing speeds in the Deary-Liewald and Stroop tasks respectively (the more one adheres to this kind of plant-based diet, the lower/quicker their reaction time speeds will be). I also hypothesize that the more plant-based one is, the higher their cognitive flexibility will be. BMI is something that will need to be addressed in the current study as it could be a confounding factor. With information from previous research, I also expect to find that a higher degree of plant-based diet will correlate with lower BMI. I also expect to find group differences in the degree of plant-based for those diagnosed with high cholesterol (compared to those with lower cholesterol) or high blood pressure in individuals (compared to lower blood pressure).

The results of this study could have a nationwide impact. If it is found that diet does indeed have a relationship with reaction times, and certain diets increase the participants' cognitive functioning, there could be changes in what meals soldiers eat, what food schools provide students for their lunch, or what is typically on the menu at restaurants when people go out to eat. People are inclined to make changes when it benefits themselves. If my study shows that plant-based diets, which are hypothesized to be related to quicker reaction times due to their low cholesterol intake (Biase et al., 2007), are indeed better for one's body and health, then people might be more likely to make the change. This will not only better people themselves, but possibly the world as a whole.

Second, the results of this study may demonstrate a positive correlation between plant-based diets and quicker reaction times, which might indicate a connection between a cholesterol-heavy diet and its adverse effects on the body and mind. A greater

understanding of diet and its role in human cognition could bring around a revolution for healthier, more sustainable diets. These diets, as a by-product, could help mitigate animal suffering due to the current mass-animal agriculture industry as there would be less demand for it, leading to its decline. This could lead to a better world that will help future generations prosper by having less pollution, less land occupied by farming that is needed to sustain current animal agriculture practices, and further empathy towards all living beings.

Method

Participants

The study population of college students is represented by a convenience sample of Georgia Southern students in psychology classes who volunteered for the study through the psychology research pool (SONA system). Participants received one research credit in the SONA system. They were compensated even if they skipped items as long as they reached the end of the survey so a participation code could be generated. A total of 264 participants began the survey, with 224 participants fully completing the survey and required experiments; 40 participants (15% attrition rate) were excluded from the analyses due to either not fully completing all the necessary parts of the study, or due to concern of nonresponse bias. Regarding ethnicity, participants were 62.5% White, 22.8% Black, 7.6% Hispanic/Latinx, 3.6% Biracial/Multiracial, 1.8% Asian, and 1.3% Not Listed/Other. Participants were 73.2% Female, 21.4% Male, 2.2% Non-Binary, 0.9% Transgender, and 2.2% Not Listed/Other. Average participant age was 20.53 years (*Mdn* = 20.00, *SD* = 3.64) with a range of 27. Participant diets were 60.3% Omnivore, 29.5%

Carnivore, 4.5% Plant-Based, 2.2% Pescatarian, 1.8% Ketogenic, and 1.8% Not Listed/Other.

Materials

Simple Reaction Time. The study incorporated the Deary-Liewald Reaction Time Test (Deary et al., 2011) as a simple response time task. The simple test uses a computer to record reaction time speeds in milliseconds and requires the participant to press the spacebar on the computer when an x fills a box that is located on the screen. Higher time scores show that the participant had slower reaction time speeds. The choice test is a continuation of the simple test, but instead uses four buttons on keyboard and prompts the corresponding letters/characters on the screen. The participant is then timed on how quickly they can match the appearing letter with the appropriate keyboard button. See Appendix for more details.

Processing Speed & Attention Capacity. The Stroop Test (Stroop, 1935) was used to measure the participants' processing speed as well as their attention capacity. The Stroop Test provides a simple measure for fluid intelligence to help control for individual differences in the test, as well as helping to build upon the Deary-Liewald test to help provide a more accurate measure. The Stroop Test consists of asking the participants to pick the color of the word displayed, which helps measure their flexibility in cognitive thinking or their processing speed and attention capacity (i.e., the word "Purple" will be displayed in the color green, and participants must pick the color green to be right, whereas if they pick the color purple they would receive no points). Fluid intelligence will not be measured directly in this study due to the high costs of intelligence tests, where a typical test license can run into the thousands of dollars, as well as the extensive

time many of these intelligence tests take, which could deter participants from participating. There is also the concern of testing fatigue that can occur from participating in too long of a study, which can result in a lack of attention towards the study from the participants and a lack of accuracy in their data. MacLeod (1991) did an integrative review of the Stroop task which incorporated 50 years of research, where he offered many various insights into the history of it, as well as the applications for which it can be used. He also delved into how it is a sound system of measurement for processing speed and is a valuable resource for understanding certain cognitive functions in humans that other tests are not able to, such as processing speed, attention capacity, and fluid intelligence.

Cognitive Flexibility. A Cognitive Flexibility Scale (CFS; Martin & Rubin, 1995) was given to participants to get a self-report of their Mental Flexibility, or their ability to switch between different thoughts and actions. The scale consists of 12 questions pertaining towards people's beliefs and feelings about their own behavior. The CFS has demonstrated no significant differences by gender (Martin & Rubin, 1995). Cronbach's alpha for the CFS for the current data set was measured at $\alpha = .736$, indicating sufficient internal consistency. Dennis and Vander (2010) presented three studies examining the validity of the CFS, providing evidence of the scale's construct validity as well as its utility in assessing cognitive flexibility.

Diet. The primary measure was an ordinal self-report rating scale indicating diet from meat-based (1) to plant-based (10). Other diet-related questions in the study included, "What diet do you identify with? (Vegetarian, Pescatarian, Vegan/Plant Based,

Carnivore, Keto, Other)" and "How long have you been on your current diet?" Please see Appendix for a complete list of questions.

Health Related Questions. BMI information was gathered from the participants from two questions. The first question asked them how tall they were, in inches, and the second question asked them for their weight in pounds. A simple BMI formula was used to convert the pound and inches into a measure of BMI for the participant: weight (lb) / [height (in)]^2 n)]- x 703. Blood pressure and cholesterol were measured via self-report from the participant, where the participant was asked whether or not they have ever been told by a doctor that they have problems with either high blood pressure or high cholesterol.

Demographics. A demographic survey was used to gain general information about the participant's age, gender, ethnicity, and education level/year in college. This is in line with standard APA protocol that requires a certain amount of demographic information to be obtained.

Procedure

Institutional Review Board (IRB) approval for this study was granted by Georgia Southern University (Protocol H23230). The study gained IRB approval on February 23, 2023 and began on March 8, 2023, running until April 24, 2023. Participants for the study were given informed consent online through Qualtrics. If informed consent was not obtained, the participant was not able to go on with the study. The two main tasks, the Deary-Liewald Reaction Time task, and the Stroop task, were then given to the participants through PsyToolKit (PsyToolKit, 2022). The participants reached PsyToolKit through their Qualtrics survey via an external link which would send them to

the two tasks. PsyToolKit recorded their times through their servers, and the participants were redirected back into Qualtrics to continue where they left off. The participants were then given a brief survey through Qualtrics which included the Cognitive Flexibility Scale; questions about their diet and exercise, questions pertaining to their general health and information utilized to calculate their body mass index, and general demographic questions. After the survey concluded, participants were debriefed on the nature of the study and primary research questions. The participant was then given one research credit through SONA.

Results

Please see Table 1 for descriptive statistics and all correlational analyses. In this study, I predicted that a higher degree of plant-based diet would have a negative correlation with both reaction time speeds and processing speeds (faster processing). Spearman correlations were utilized for the analyses given the ordinal scale of the diet measure and non-normal distributions for many of the factors. The Spearman correlation allows for these variations in distribution due to its flexible nature, allowing a good measure of correlation between the variables to still be able to be analyzed. Contrary to what was hypothesized, there was no significant correlation between degree of plant-based diet and, respectively, reaction time speeds from the Deary-Liewald Simple, and Deary-Liewald Choice. There was also no significant relationship between the degree of plant-based diet and the Stroop Task processing speed measure.

Second, cognitive flexibility was hypothesized to show a positive correlation with the degree of plant-based diet, meaning as one adheres to a more plant centered diet, they would have a higher degree of cognitive flexibility. Contrary to the hypothesis, there was

no significant relationship found between the Cognitive Flexibility Scale and the degree of plant-based diet for the participants in this data set.

Third, Body Mass Index (BMI) was hypothesized to be negatively correlated with the degree of plant-based diet, meaning that with more plants in the diet, we would also expect lower BMI. This hypothesis was not supported. There was no significant relationship between BMI and degree of plant-based diet.

Table 1

Descriptive Statistics and Correlations for Study Variables

Variable	*M*	*SD*	1	2	3	4	5	6
1. Diet (Scale from 1-Entirely Meat based to 10-Entirely Plant based)	4.33	1.68	--					
2. Cognitive Flexibility Scale (Mean Score)	4.52	0.56	.059	--				
3. Deary-Liewald Simple	286.01	45.70	.036	.000	--			
4. Deary-Liewald Choice	463.23	80.06	.128	-.039	.497**	--		
5. Stroop Task	954.28	143.29	-.051	-.190*	.202**	.496**	--	
6. BMI	26.72	8.24	.027	.030	.060	-.002	.010	--

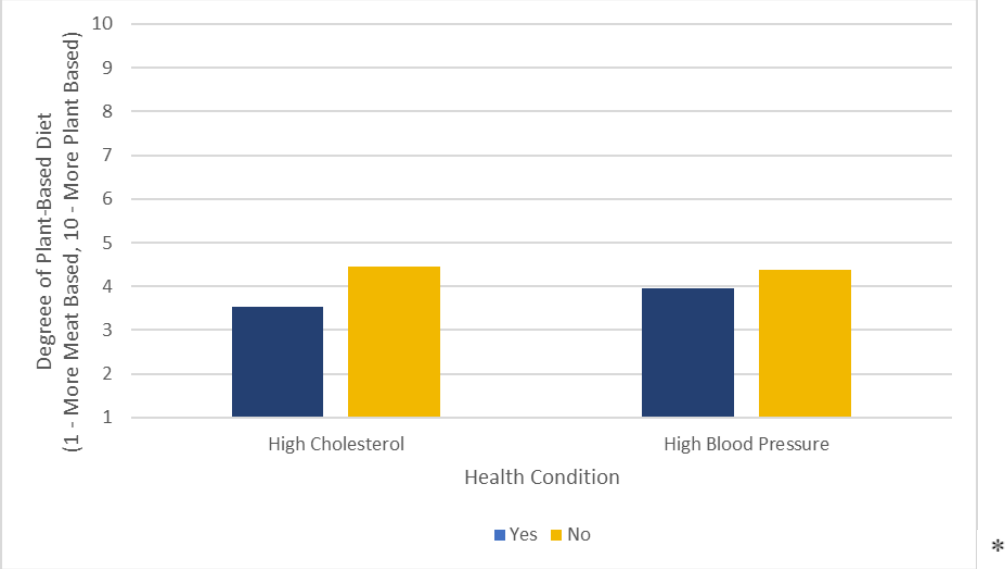
Note. BMI = Body Mass Index. *$p < .05$. **$p < .001$.

Fourth, I hypothesized that those with a higher degree of plant-based diet would be less likely to have certain health related problems, specifically with high cholesterol and high blood pressure. A Mann-Whitney *U*-test indicated that reports of high cholesterol (versus not) were significantly greater for those with a lower degree of plant-based diets (*Mdn* = 3) than for those with a higher degree of plant-based diet (*Mdn* = 5), $U = 1603.00$, $p = .002$. I supported the hypothesis that there would be a difference in high

cholesterol problems due to the degree of plant-based diet one has. However, a Mann-Whitney *U*-test indicated no significant differences in reported history of high blood pressure (versus not) between those with a lower degree of plant-based diet (*Mdn* = 4) or higher degree of plant-based diet (*Mdn* = 5), *U* = 2017.50, *p* = .250. Please see Figure 1.

Figure 1

Potential Health Outcomes Based on Degree of Plant-Based Diet



Note. **p* < .05.

Discussion

The findings indicate that there was a relationship between degree of plant-based diet one and health risks for high cholesterol. This directly relates to the previous findings from Biase et al. (2007) where it was found that a vegetarian diet was associated with lower levels of low-density lipoprotein (LDL), as well as lower total cholesterol levels when compared to that of the diet of omnivores in their study. Due to a more plant-based diet having lower cholesterol, as plants do not contain cholesterol, these findings are also consistent with the study by Zhong et al. (2019) where it was found that each additional

300 mg in a diet is associated with significantly higher risks of a cardiovascular disease incident. This shows that there is a large benefit of having a primarily plant-based diet for maintaining healthy cholesterol levels as well as lowering the risk of cardiovascular disease.

There were many non-significant results, such as the degree of plant-based diet one adheres to not relating to the two cognitive tasks, the Deary-Liewald Simple Reaction Time Task and the Stroop Task, or to cognitive flexibility. This result is inconsistent with previous findings such as that of Trepanowski et al. (2018) where an experiment was run to determine the effects of a vegan diet; these participants followed a strict adherence to the diet over the course of the 6-week experiment. These results, unlike the one in my study, were able to show that there was better executive functioning and processing speeds for the participants assigned to a vegan diet compared to the participants who were assigned to the omnivore diet.

There was also a lack of relationship found between BMI and degree of plant-based diet, contrary to previous findings from Medawar et al. (2020). All these non-significant results are likely due to confounds within the study, or due to the cross-sectional nature of my research. Many of the previous studies, such as the study from Trepanowski et al. (2018), used longitudinal methods with the same participants, measuring their change over time. The study that I did, however, did not use this method primarily due to a lack of time given the time constraints of the Honors Thesis project. Future studies should incorporate a longitudinal research design or experimental research design, as they both offer more control over the environment of the participants, which would reduce unsystematic variability. Another critique of my study is its online data

collection method. There were no proctors to ensure that the participants were focused and answering reliably; it was based on an honor system. Without external supervision of the participants, the data cannot be ensured to be answered as accurately and honestly as possible. Things such as weight, height, self-report measures, and even the participants' focus during the two cognitive tasks are brought into question. Further studies on the topic may include proctored tasks with some sort of supervision from the researcher or a research assistant.

In future studies on the topic of cognition and diet, it would also be important to have more control over the diet of the participants, possibly even measuring the participants change throughout the duration of the experiment and due to their diet, which could be done in a pre-post design. The participants' diets in my study were all self-reported, which can bring into question how accurately and honestly they reported. Future studies may incorporate better incentives and stricter instrumentation, such as journaling, photographing meals, tracking macronutrients of their meals through apps or spreadsheets, as well as documenting what ingredients make up each of their meals to ensure better adherence to the diet assigned.

Conclusions and Next Steps

Despite the limitations, the idea of cognition relating to diet, and the idea that plant-based diets can provide healthy sequelae is worth exploring. There are many new diets coming into people's view, and it is important to understand how some of them may provide benefits, while some of them may prove to be harmful. A plant-based diet offers an alternative to meat eating but can still allow one to function cognitively the same, or perhaps even better. Its low impact on the environment is one of its main driving forces,

and if further studies find it to be comparable to other diets with heavier environmental impacts, it may offer an alternative for the environmentally conscious individual to sustain themselves.

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Appendix

COLLEGE OF Behavioral and Social Sciences
DEPARTMENT OF Psychology

Diet and the Role It Plays In Recognition Speed

This research is being conducted by Ryan Lavrisa, Honors College student of Psychology at Georgia Southern University, under the mentorship of Dr. Virginia Wickline in order to understand more about students' diet and how their diet relates to their cognition, specifically their reaction times, processing speeds, and mental flexibility.

Purpose of the study: The purpose of this research is to determine how much of a relationship exists between the participants diet and their cognition, specifically their reaction times, processing speeds, and mental flexibility.

Procedures: For participation in this research you will take part in two tasks, the Deary-Liewald Simple Reaction Time Task and the Stroop Task, afterwards the participant will take part in a questionnaire which includes a measure for mental flexibility (Cognitive Flexibility Scale) as well as related questions on diet and demographic information.

Discomforts and Risks: There are no risks to you beyond those encountered in everyday life. If you feel uncomfortable, you may skip any question or skip to the end of the survey at any time without penalty or loss of benefits. Your identity will be kept confidential through the SONA system. Your computer's IP address will not be collected. The responses are being collected with software that is designed to secure the data and provide you with confidentiality. Nevertheless, despite these safeguards, there is always a remote possibility of hacking or other security breaches that could compromise the confidentiality of the information you provide. For that reason, we encourage you to be sure that you complete this study from a computer with updated virus protection.

Benefits: When you complete this study you will be granted 1 SONA research credit. As a result of participating in this study, you may become more aware of your reaction time for certain tasks.

Duration: This study will take approximately 30 minutes to complete.

Statement of Confidentiality: When you reach the end of the survey on Qualtrics, a numeric identification (ID) number will be generated, which will be recorded in SONA. Only the principal investigator, Ryan Lavrisa, and his faculty mentor, Dr. Wickline, will have access to the SONA site to link your name to your survey responses. The researchers will have access to your survey data which will be stored on a password-protected computer, network drive, or Google drive. Your responses will be maintained in this secure location for a minimum of 3 years following completion of the study.

Future use of the data: Deidentified data from this study may be placed in a publicly available repository for study validation and further research. You will not be identified by name or ID

number in the data set or any reports using information obtained from this study, so your confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

Right to ask questions: You have the right to ask questions and have those questions answered. If you have questions about this study, please contact the primary researcher named above, whose contact information is located at the end of the informed consent. For questions concerning your rights as a research participant, contact Georgia Southern University Institutional Review Board at 912-478-5465.

Compensation: When you complete this study you will be granted 1 SONA research credit. If you open the survey but skip questions or withdraw from the study, you will still receive your SONA credit as having completed the study as long as you skip forward to the final screen. Please do not just close your browser. If you do, your participation cannot be verified through SONA, as no ending code will be generated, so no credits can be granted.

Voluntary Participation: You are not required to participate in this research. You may end your participation at any time by closing out of the survey window on your computer. You do not have to answer any questions that you do not want to answer.

Penalty: You may decide at any time that you do not want to participate further and may withdraw without penalty or retribution.

You must be 18 years of age or older to consent to participate in this research study. If you consent to participate in this research study and to the terms above, please check the boxes below.

Please print this screen for your records. Printing this screen can be accomplished by hitting the 'Print Screen/F11' key on your keyboard or selecting print in your browser window. If a printer is unavailable, the contents of this page can be copied by highlighting this text, right clicking, and selecting "copy." Then, in a blank document again right click and select paste. Retain this electronic document for your records. If you are unable to retain this information but wish to receive a copy, contact Dr. Virginia Wickline, and she will provide a print and/or electronic version of this information.

This project has been reviewed and approved by the GSU Institutional Review Board under tracking number H23230.

Title of Project: Diet and the Role It Plays In Recognition Speed
Principal Investigator: Ryan Lavrisa, Department of Psychology, Armstrong Campus, 11935 Abercorn Street, Savannah, GA 31419, 912-484-9371, ryanlavrisa@gmail.com

Completion and return of the survey imply that you agree to participate and that your data may be used in this research. If you agree to continue with this survey, please check all of the following statements:

I have read the information above and give consent to participate voluntarily in this study.

- Yes

- No

I am at least 18 years old.

- Yes
- No

You will be given a code below. Copy this code to your clipboard (highlight the code and then press Ctrl + C for Windows, or Command + C for Mac) or write it down. Keep track of this code as it will be used in this survey.

6620159

The following link below will send you to the external experiment page. Please make sure you have your code on hand, as it will be used to keep track of your experiment times.

Experiment Page

I have completed the experiment and am ready to move to the next page.

- ◯ Yes
- ◯ No

(**NOTE: The link given, marked as Experiment Page will take participants to Psytoolkit where they will be asked to input their given code as well as consent to taking the two tasks. The initial page is shown on the next page of this document.)

About this study

There will be two tasks on the following pages which are crucial for the continuation of the survey you have started through SONA.

This study will have two tasks to measure your current cognitive preformance.

These two tasks should take no less than 5 minutes and no more than 15 minutes.

There will be a **random, unique 7-digit code** given to you in the previous window. Please make sure that you have this code, and if not, please return to the previous survey to gain access to it. This code will be used to track your experiment times and is crucial for data gathering.

Contact information

Information about this study:

Georgia Southern University

Honors College

Department of Psychology

Contact email: rl09625@georgiasouthern.edu

Important technical requirements for your computer

You seem to use the following browser (version number in brackets): Chrome (109)
Your browser supports the requirements of this survey.

For this study, you need to have a real keyboard.

Confirm you want to do this survey

Please confirm that you want to participate in this survey.

☐ I understand the conditions of this study

Click this button to start survey

Important data protection information

When you start, this survey will store your answers and browser information on the PsyToolkit server.The responsibility for this survey rests entirely with the researcher(s) listed above. Click here if you do not want to participate now.

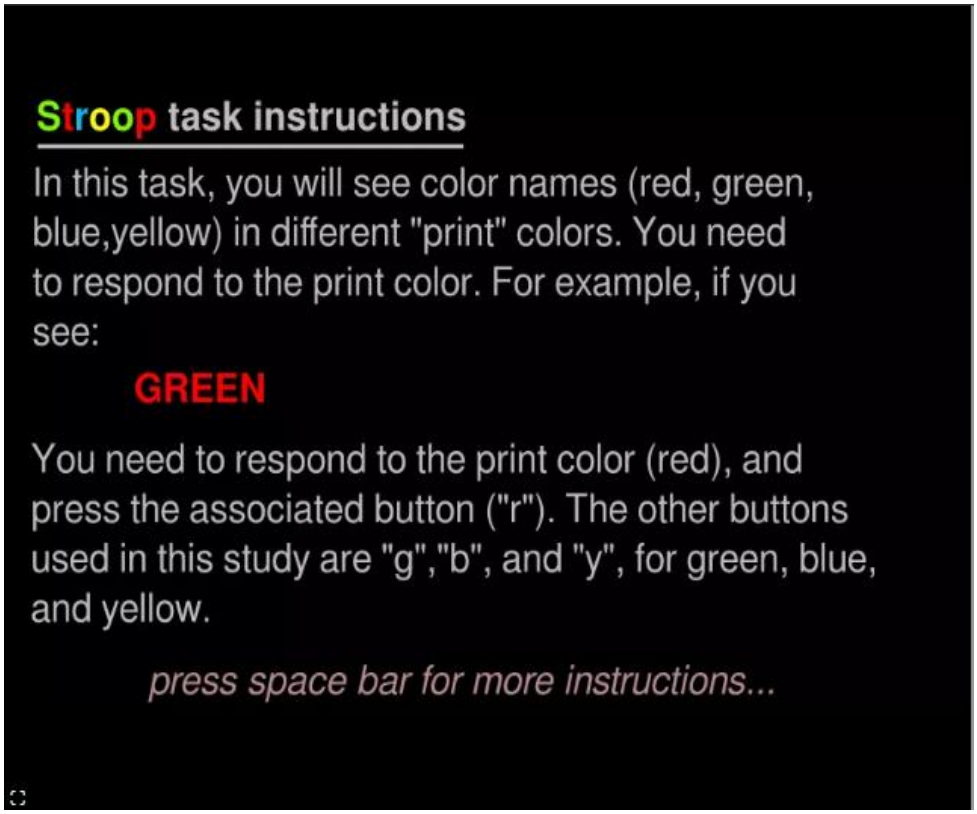
Please enter the code given from Qualtrics in the following text box.

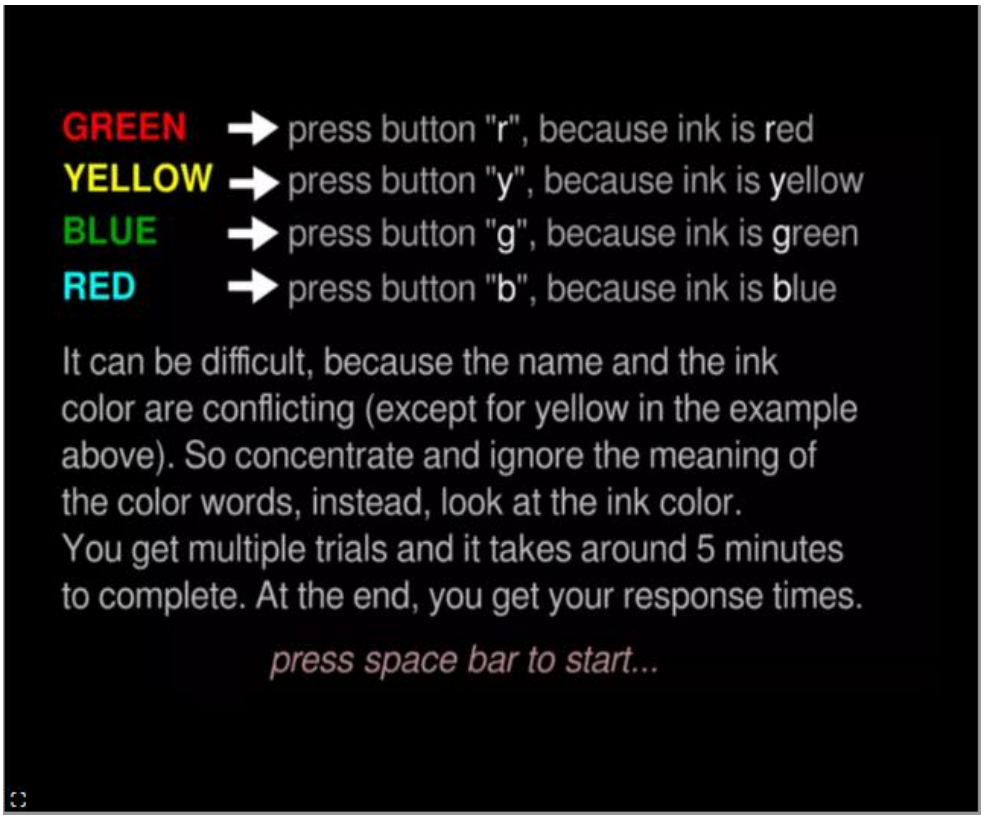
Code

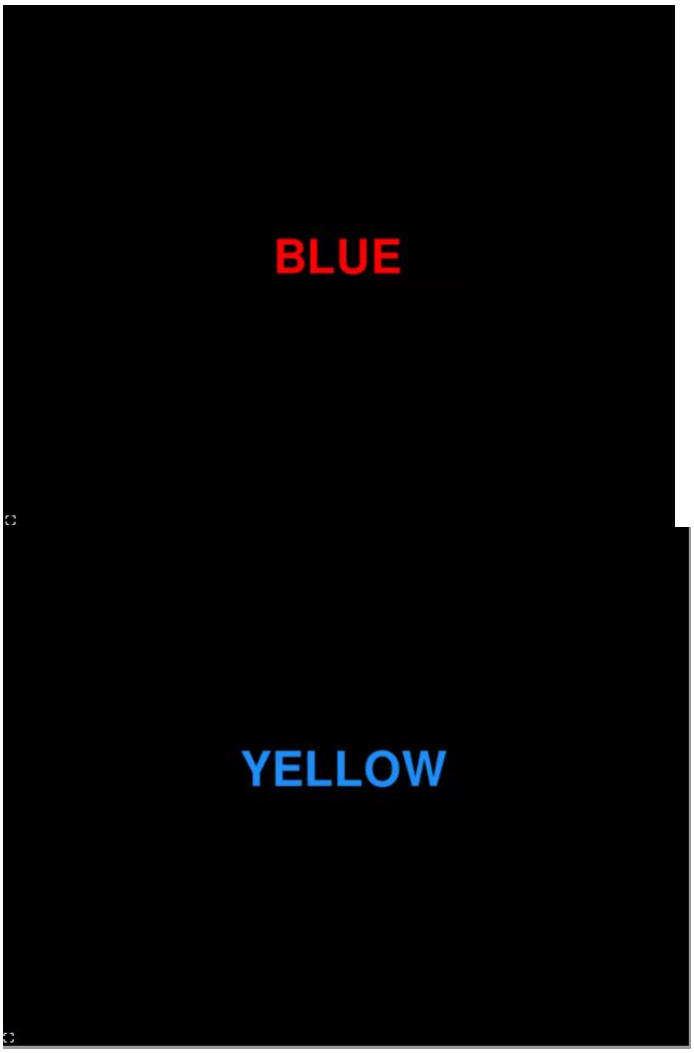
Click this button to continue

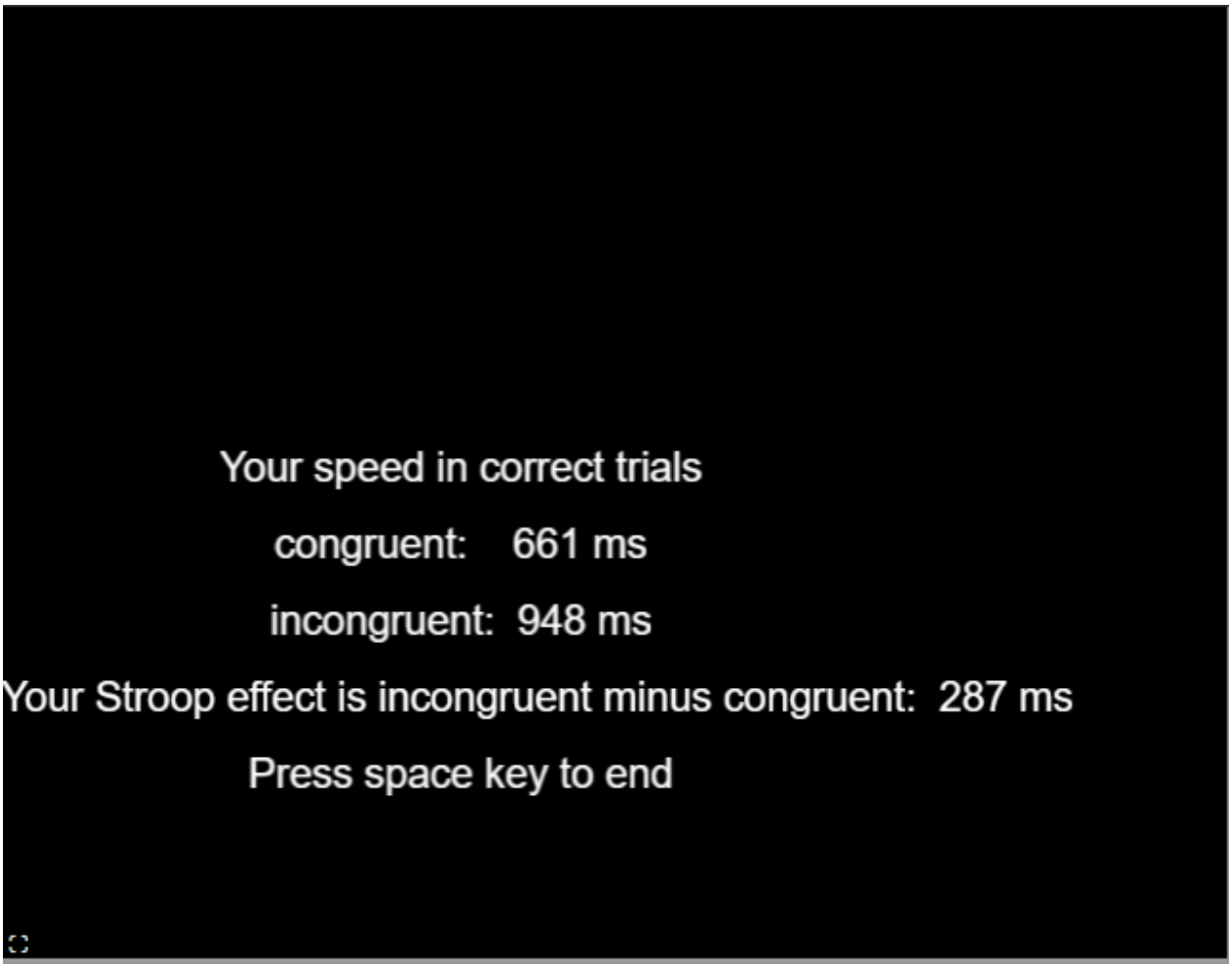
The code given through Qualtrics will be inputted here, before they move on to the Stroop Task and Deary-Liewald Simple Reaction Time Task.

Stroop Task (Stroop, J.R., 1935)



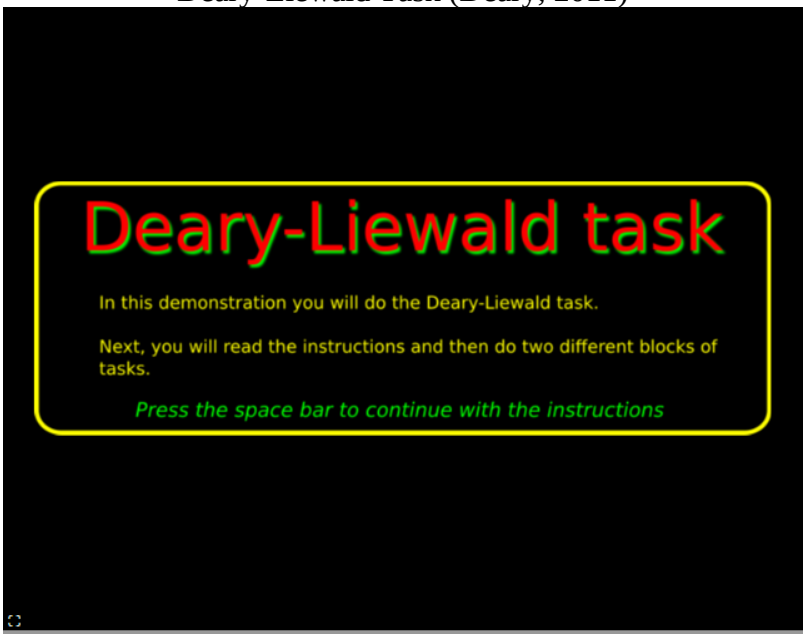



BLUE
YELLOW



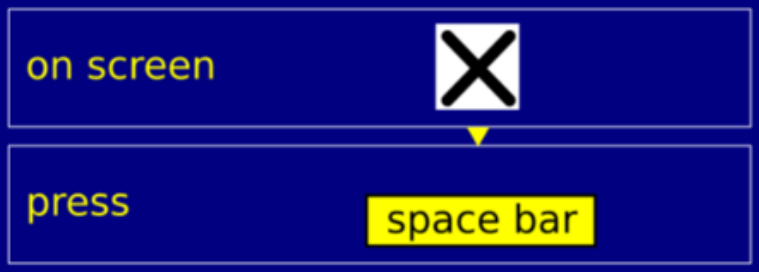
Shown above is the result for an example Stroop Task.

Deary-Liewald Task (Deary, 2011)



Simple task

In the following task, you see one white box on the screen. When a cross appears, press the space bar as fast as possible. You will have to do this **multiple times**, and the time when the cross appears varies slightly from trail to trial.

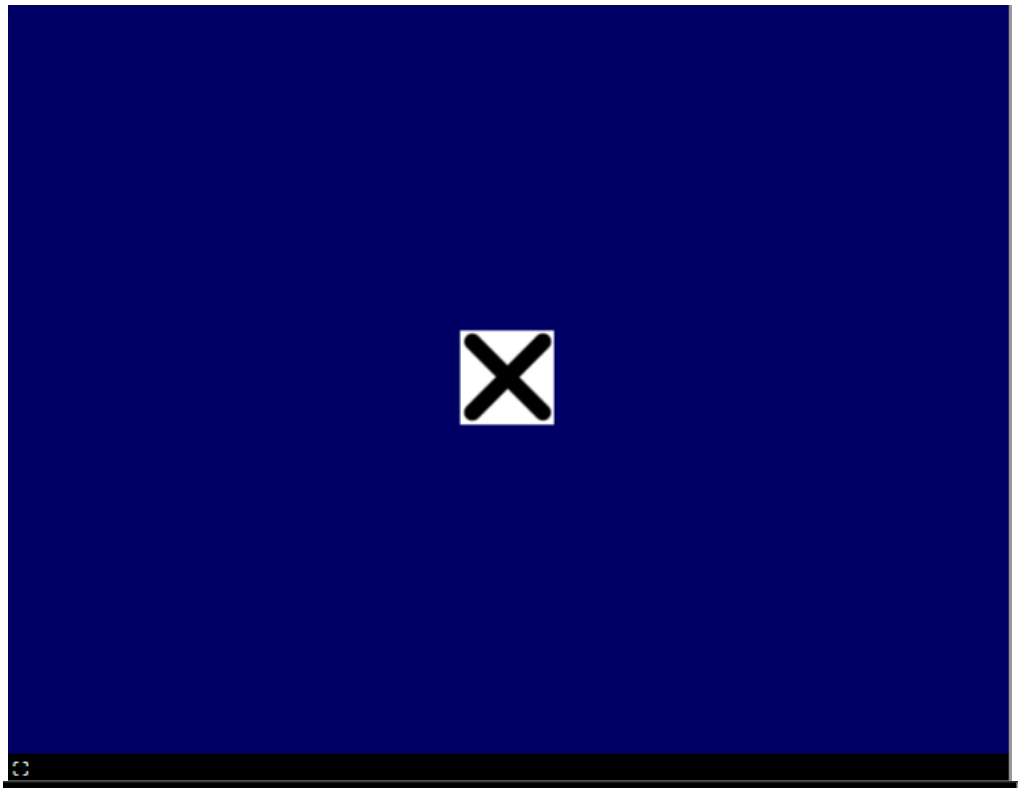


Press space to continue...

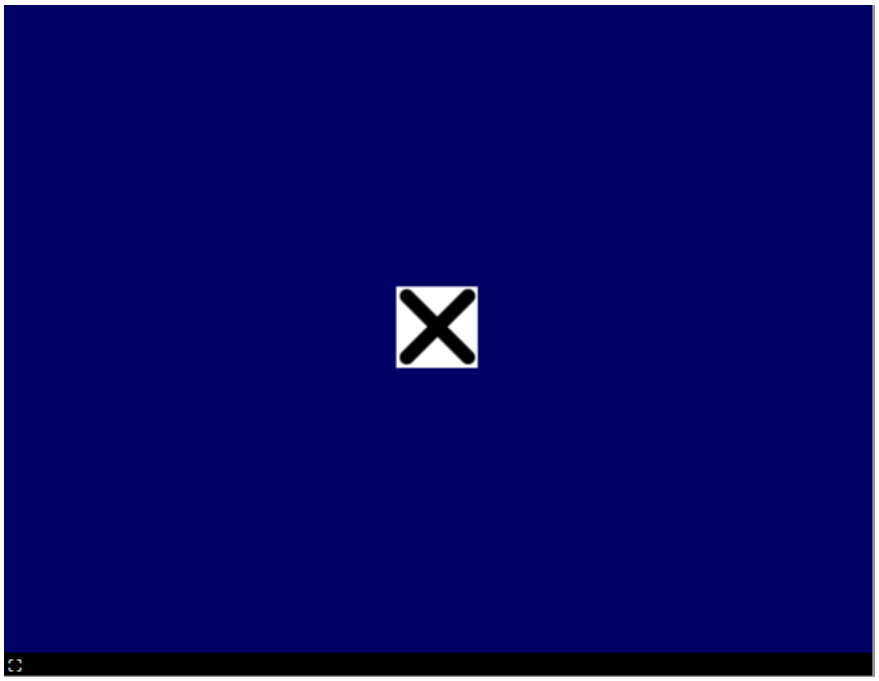
First a few training trials to warm up

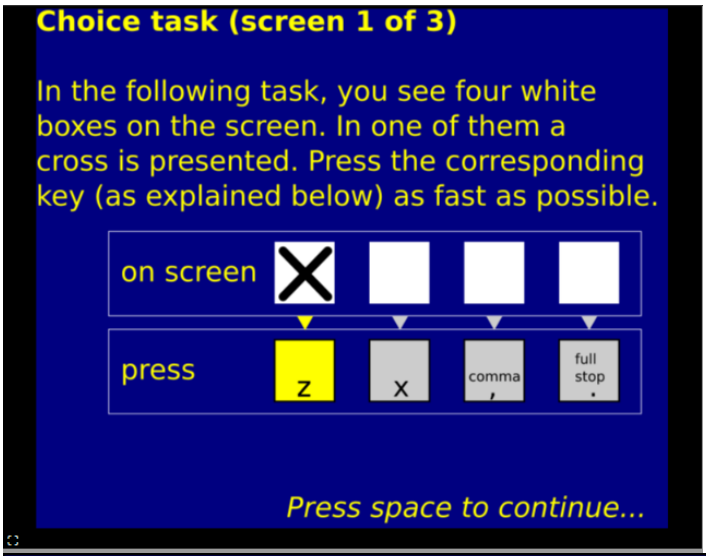
Respond as fast as you can!
This task is about speed!

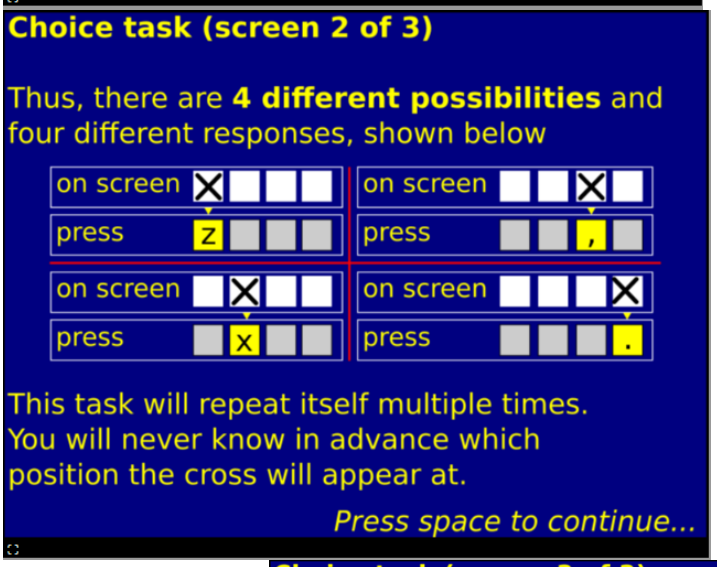
Press space bar when ready to start!

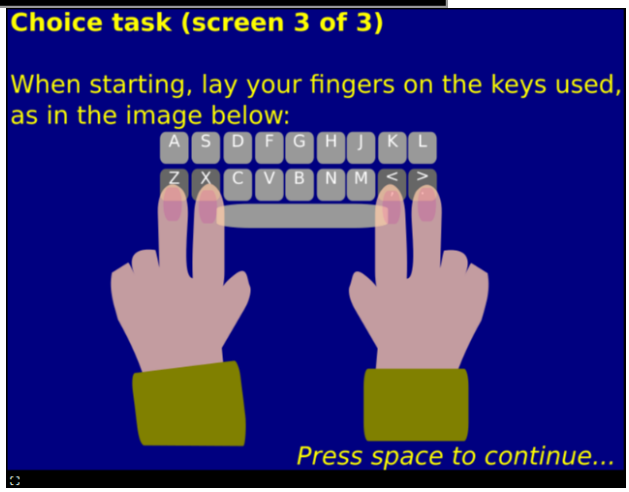


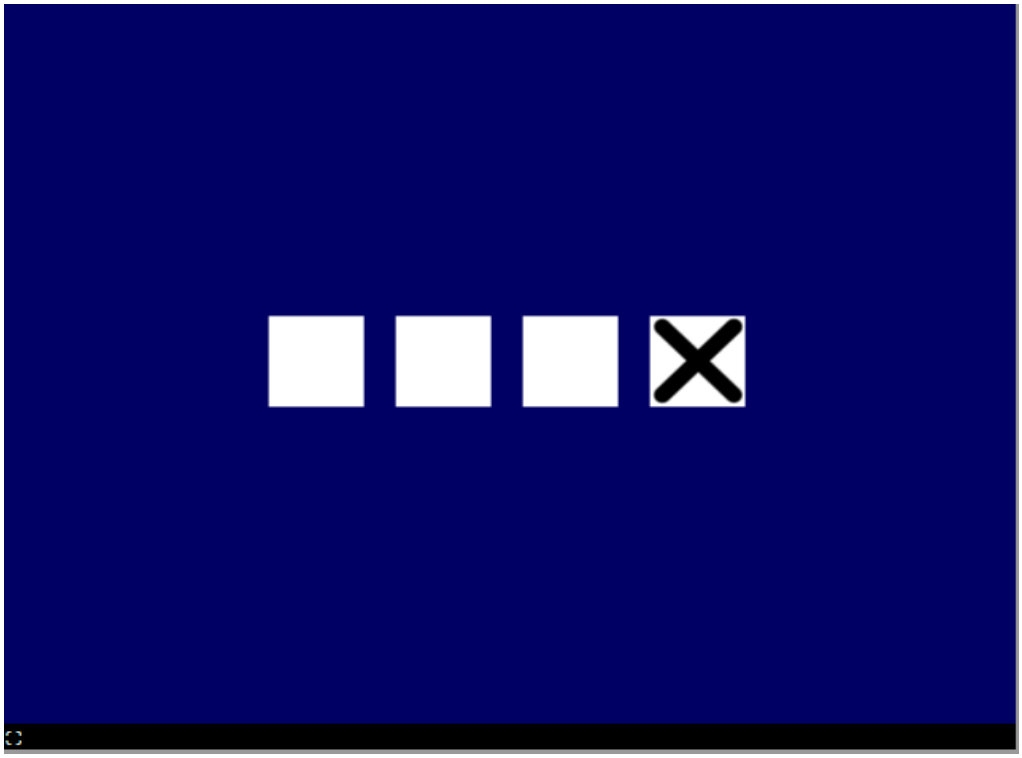

Now comes the real test of your speed
Respond as fast as you can!
This task is about speed!
Press space bar when ready to start!

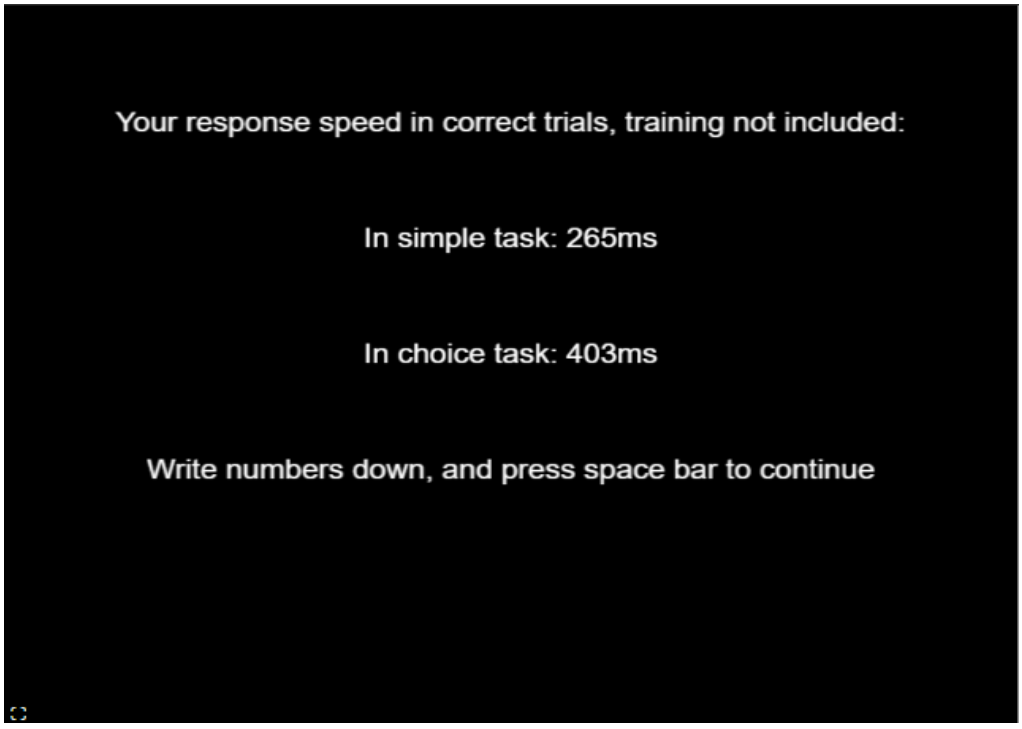



Choice task (screen 1 of 3)
In the following task, you see four white boxes on the screen. In one of them a cross is presented. Press the corresponding key (as explained below) as fast as possible.
on screen
press
z
x
comma ,
full stop .
Press space to continue...


Choice task (screen 2 of 3)
Thus, there are 4 different possibilities and four different responses, shown below
on screen
press
z
on screen
press
,
on screen
press
x
on screen
press
.
This task will repeat itself multiple times. You will never know in advance which position the cross will appear at.
Press space to continue...


Choice task (screen 3 of 3)
When starting, lay your fingers on the keys used, as in the image below:
A S D F G H J K L
Z X C V B N M < >
Press space to continue...





End of Task Script:

Thank you for completing these two tasks, your participation is greatly appreciated!

Please exit this page and continue back to Qualtrics for the remaining survey questions.

Survey Section of Study

Cognitive Flexibility Scale (Martin, & Rubin, 1995)

Read each statement and respond by selecting how much you agree or disagree with each statement.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
I can communicate an idea in many different ways.						
I avoid new and unusual situations.						
I feel like I never get to make decisions.						
I can find workable solutions to seemingly unsolvable problems.						

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
I seldom have choices when deciding how to behave.						
I am willing to work at creative solutions to problems.						
In any given situation, I am able to act appropriately.						
My behavior is a result of conscious decisions that I make.						

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
I have many possible ways of behaving in any given situation.						
I have difficulty using my knowledge on a given topic in real life situations.						
I am willing to listen and consider alternatives for handling a problem.						
I have the self-confidence necessary to try different ways of behaving.						

Where on the scale below would you place your current diet?
Values range from 1 (entirely meat-based diet) to 10 (entirely plant-based diet).

- Meat-Based — Omnivore — Plant Based
- 0 — 10

Which diet do you currently identify the most with?

- Carnivore (meat-based)
- Ketogenic
- Omnivore
- Pescatarian
- Vegetarian
- Vegan (plant-based)
- Other (specify below)

How long have you been on your current diet (in months, to the closest whole number please, i.e. 7)

[Text Box for Participant Response]

Are you on a gluten free diet?

- Yes - Gluten Allergy (Celiac Disease or other allergy type)
- Yes - By choice
- No

How often do you play video games?

Values range from 1 (never) to 10 (daily).

- Never
- 0
- Daily
- 10

How many hours per week do you exercise on average? (in whole numbers only please. i.e. 3)

[Text Box for Participant Response]

Have you ever been told by a doctor that you have high cholesterol?

- Yes
- No

Have you ever been told by a doctor that you have high blood pressure?

- Yes
- No

How many hours of sleep did you get last night? (in whole numbers only please, i.e. 8)

[Text Box for Participant Response]

What is your height in inches? (in whole numbers only please, i.e. 68)

[Text Box for Participant Response]

What is your weight in pounds? (in whole numbers only please, i.e. 230)

[Text Box for Participant Response]

Race/Ethnicity:

- African/African American/Black
- American Indian/Native American
- Asian/Asian American
- Biracial/Multiracial
- European American/White
- Hispanic/Latino/Latina/Latinx/Latine
- Middle Eastern or North African (e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, etc.)
- Pacific Islander/Pacific Islander American
- Self-identify (specify below)

Gender:

- Cisgender Man (Born Male - Still Identify as Male)
- Cisgender Woman (Born Female - Still Identify as Female)
- Non-Binary
- Transgender
- Self-identify (specify below)

Grade Level in College

- First year
- Sophomore
- Junior
- Senior
- Other (specify)

What is your age? (in years, to the closest whole number, i.e. 19)

[Text Box for Participant Response]

Debriefing:

This survey's intended purpose is for assessing one's performance on cognitive tasks, and seeing if there is any relationship between their performance on the task, and their diet. The survey also aims to find out if there is a relationship between one's Cognitive Flexibility (one's ability to switch between different thoughts and actions) and their diet.

End of Study 'Thank you' message:

We thank you for your time spent taking this survey. Your response has been recorded.

Study Information for SONA Research Participation Site

Study Name: Diet and the Role It Plays In Recognition Speed
Study Type: Online external study
Duration: 30 minutes
Credit: 1 credits
Abstract: This study asks you to complete two cognitive tasks, as well as a related survey questionnaire which asks questions about your diet, sleep, and other demographic information.
Description: As a student at Georgia Southern University, you are invited to participate in a 30 minute online survey conducted by Ryan Lavrisa (rl09625@georgiasouthern.edu). This study asks you to complete two cognitive tasks, as well as a related survey questionnaire which asks questions about your diet, sleep, and other demographic information. This study has been exempted by Georgia Southern's IRB (protocol H23230). If you choose to participate in this study, you will receive 1 SONA research credits. TO RECEIVE CREDIT FOR COMPLETING THE STUDY, you must reach the end of the survey. If you choose to skip questions or stop responding, make sure you click the forward arrows to reach the survey's end. If you close your browser early, you will not be able to receive credit.

Eligibility requirements: Must be 18 or older. Must currently be enrolled as a student at Georgia Southern University. Must complete the study on a device with a keyboard (not a cell phone).

Please continue to **this link** to complete the survey.

Research: Does your diet affect your body's abilities to react?

Support Undergraduate Student Research – Please Take Our Study

You must currently be enrolled in a psychology class at Georgia Southern University
to be involved in this study.

As a student at Georgia Southern University, you are invited to participate in a 30 minute online survey conducted by Ryan Lavrisa (rl09625@georgiasouthern.edu). This study asks you to take two online experiments, one of them being the famous Stroop Task, and provide some information about yourself and your diet. This study has been approved by Georgia Southern's IRB (protocol H23230).

If you choose to participate in this study, you will receive 1 SONA research credits.

Exclusion criteria: If you are under the age of 18, or are NOT currently enrolled in Georgia Southern University psychology class, you are ineligible for this study. You must complete this study on a device with a keyboard (not a cell phone).

Please go to SONA today to complete the study!

Diet and the Role It Plays In Recognition Speed