UNIVERSIDAD SAN FRANCISCO DE QUITO USFQ

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Inhibition or speed of processing? What does a delay response choice reaction time task measure?

.

José Nicolás Murgueitio Meneses

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Calificación:

Nombre del profesor, Título académico Nergiz Turgut, Ph.D.

Firma del profesor _____

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Firma del estudiante: _____

Nombres y apellidos: José Nicolás Murgueitio Meneses

Código: 00135960

Cédula de Identidad: 1724587520

Lugar y fecha: Quito, 03 diciembre de 2019

RESUMEN

El presente estudio es un esfuerzo para replicar los resultados encontrados por Jensen (1979), y compararlos con las pruebas de inhibición Stroop y Hayling. Se reclutó 40 participantes de 18-30 años los cuales realizaron 3 pruebas: Stroop, Hayling, y una prueba de cronometría mental. La prueba de cronometría mental tenia dos condiciones: ir lo más rápido posible y desacelerar la respuesta lo menos posible. Los resultados indican que no hay correlación entre ninguna de las variables, y no se pudo replicar los resultados de Jensen. Las interpretaciones sobre estos resultados no significativos son inconclusas, debido a la no-validez de las pruebas usadas. Se recomienda que para futuros estudios se validen las pruebas que pueden ser tomadas bajo interpretación como la prueba de Hayling, se haga pilotajes para las instrucciones, y se elija una población más específica y no por conveniencia.

Palabras clave: inhibición, procesamiento, cronometría mental, diseño experimental, psicología cognitiva

ABSTRACT

The present study aims to replicate the results found by Jensen (1979) and compare those results with the Stroop task and Hayling test. Forty participants with an age range from 18-30 were recruited and they all completed a Stroop Task, Hayling Test and a mental chronometry task. The mental chronometry task had two conditions: going as fast as possible and small delay. The results indicate no correlation between the variables and the results by Jensen were not replicated. The interpretations about these non-significant results are inconclusive, because of the invalidity of the measures used. It is recommended for future studies to validate the measures like Hayling, conduct pilot studies for instructions, and to choose a more specific, non-convenient sample.

Key words: inhibition, speed of processing, mental chronometry, experimental design, cognitive psychology.

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RESEARCH PROJECT

INHIBITION OR SPEED OF PROCESSING? WHAT DOES A DELAY RESPONSE CHOICE REACTION TIME TASK MEASURE?

Problem Statment

Inhibition is, mostly, an intentional process in which people repress a reaction. There has been stated that there are, at least, two types of inhibition processes going on in the brain, one is measured by the Stroop task, and the other one by Hayling test. Also, there are reports that a mental chronometry task can measure inhibition, but this hasn't been looked in dept.

Objectives

Main objective:

Identify if a delay mental chronometry task (choice reaction time) can measure inhibition in young adults, comparing it to a Stroop task and a Hayling Test.

Specific objectives:

a) Compare the reaction time between going as fast as possible and slowing as little as possible.

b) Replicate the results from Jensen (1979).

c) Replicate inhibition results found in Stroop task and Hayling Test.

d) Identify the time of inhibition of intentional responses in young adults, through a reaction experiment of choice reaction time, in order to understand the relationship between intention and action, and the role of executive functions.

Justification

The benefit of this experiment is towards the exact knowledge of differences in time of response inhibition, which might imply in the understanding of cognitive abilities of the human being and more evidence that inhibition is in fact within and forms part of high-function executive functions, therefore it takes place in sophisticated brain structures. Inhibition has implications in many mental disorders and can be part of something clearly instinctive or learned. This study will bring us closer to the answer, the greater the difference in time between the inhibited and the non-inhibited, is a greater indication that it is a higher-level cognitive function.

Theorical Framework

Response inhibition is a cognitive and cerebral process, there are several types of inhibition and the one used in this experiment will be inhibition of intentional responses. According to Jahanshahi, Obseso, Rothwell & Obeso (2015) there are several neuronal circuits that control inhibition, the basal ganglia and the fronto-striato-subtalamica-palidal network play an essential role in the usual selective inhibition. Toni, Thoenissen, Zilles (2001) stated that preparing to move relies on parietofrontal circuitry and portions of the posterior temporal sulcus, and posterior temporal cortex is related to goal-oriented behavior. As well, Aron, Robbins, & Poldrack (2004) found that inhibition lies in the prefrontal cortex and subcortical areas, and also in posterior cortical regions and the inferior frontal cortex. Aron & Poldrack (2005) confirmed that there are deficits in the interior frontal cortex

regarding inhibition processes. Also, Vendrell et al. (1995) showed that the region most related to inhibition was the right prefrontal lateral cortex.

Ainslie (1975) found that inhibition is choosing something less rewarding, over something else. That is, when human beings inhibit their responses, they are going for something that causes them less desire. Floden & Stuss (2006) did a stop signal task to estimate inhibitory speed in normal and patients with lobal lesions. Data showed that frontal lobes are necessary for inhibitory control and the right superior medial frontal is key to control strategically slower responses. Which means that intentional inhibition is also involved or related to other higher cognitive processes. Wylie, Ridderinkhof, Eckerle, & Manning (2007) showed that there's an inefficient on inhibition of responses in patients with mild cognitive impairment compared with controls. These results agree with those of Wylie et al. since they indicate that inhibition is a high-level executive function. Posner, Rafal, Choate & Vaughan (1985) showed that patients with midbrain lesions had impaired inhibition function.

Regarding the intention to respond, Toni, Thoenissen & Zilles (2001) found that the preparation for a movement is based on parieto-frontal circuits and portions of the temporal posterior gyrus, they also found that the parieto-frontal cortex evaluates the motor processes before performing them. Collete et al. (2001) found that response inhibition showed increased activity in left prefrontal areas, using the Hayling Test. Bekkering & Neggers (2002) discovered attentional benefits in response intention which involve increased visual orientation. Reaction time has been used since the beginning of experimental and cognitive

psychology. This has been used to correlate with other mental processes and individual psychological characteristics of each person. Finding differences in reaction time is of the important to understand executive functions and cognitive control. Jensen (1979) asked the subjects to slow responses as little as they could. Deliberate slowed response times were about 8 standard deviations slower than the ones that weren't deliberate slowed.

There are other factors that can affect inhibition or cognitive control, in 2010 Luk, Anderson, Craik & Grady found in their experiments that monolinguals and bilinguals were activating different brain structures in inhibition tasks. Bilinguals activated bilateral frontal, temporal and subcortical regions, while monolinguals activated temporal and left superior parietal regions. Blumenfeld & Mariam (2011) study also confirms that inhibition processes are affected by bilingualism. Like outside factors, such as being bilingual or not, internal factors also play a crucial role in inhibition. Logue & Gould (2014) found that dopamine, norepinephrine and serotonin play a central role in executive functions, including inhibition. Other things, such as pathologies also affect inhibition, Schachar & Logan (1990) showed that subjects with attention deficit and hyperactivity disorder had deficits in inhibitory control. Penades et al. (2007) found that patients with Obssesive Compulsive Disorder had impaired inhibitory mechanisms. Rosenberg, Dick, O'Hearn & Sweeney (1997) found neurobehavioral inhibition in OCD patients. Carlson & Moses (2003) found that inhibitory control plays a key factor in the development of theory of mind, which is basically being able to put yourself in other situations. Other deficits in things such as working memory might also play an effect on inhibition. Kuntsi et al. (2006) found that the ability of inhibition and

working memory was related to genetics in a moderate degree. Siegel & Hasher (2000) found that deficits in inhibition might also be associated with deficits in working memory, with the latest causing inefficiencies in inhibitory control.

Using Hayling Test Nathaniel-James, Fletcher & Frith (1997) found that in the first condition of Hayling (initiation) was associated with "left-sided activation of the frontal operculum, inferior frontal gyrus, middle temporal gyrus and the right anterior cingulate gyrus". And the Hayling B (suppression) was associated with "left frontal, operculum inferior frontal gyrus and right anterior cingulate gyrus activation". Regarding the choice reaction time tasks, several studies report using this type of task as an inhibition measure. Burle & Vidal (2004) showed that inhibition does happen during choice reaction time experiment. Kornblum (1965) found that the delay in reaction time in inhibitory tasks might due to the inhibition of what's not supposed to be chosen (e.g. a choice reaction time), and not choosing the correct one.

1. Methodology

1.1.Design.

This is a quantitative study with an experimental approach. It has repeated measurements, which means that the different conditions will be applied to the same group of participants: the Stroop task, the Hayling test, and the choice reaction time task. The dependent variable in this experiment is the reaction time in each condition. Since this experiment has many tasks, and in each task, there are multiple conditions there are different independent variables: in summary, the independent variable depends on the instructions the participants were given. These instructions will affect the reaction time of the participants: for example, in the Hayling test participants will have different reaction times depending if the researchers are looking at part A or part B.

Participants.

Participants consisted of young adults, most of them college students, (n=40) from 18 to 30 years (M = 19.22, SD = 3.45). Eight of the participants were male, and 32 were female. All of the participants were Spanish native speakers as all of the tests and instructions of such tests were in that language. One of the participants, male, was excluded from the data analysis because he was color blind and couldn't perform the Stroop task as desired. He was confusing colors like red and green, every time the right answer was green, he kept saying red. Another participant, this time female, was excluded from the data analysis because during the experiment she was unable to follow directions in all three tasks. It seems that she

wasn't able to understand was she was asked to do, even though the instructions were explained to her in more depth and detail. None of the other participants presented any major disability at the level of their vision, motor function, or speaking ability.

Participant recruitment.

Participants were recruited in two semesters of the academic year: summer and fall 2019. Most of the participants were from an Experimental Psychology course at the university, in which they learn about experimental research design. Some other students were recruited from other psychology courses at the university.

Instrumentation.

The materials used for this experiment were an experimental room located at Institute of Neurosciences in Universidad San Francisco de Quito, a computer installed in the same room, a sheet of paper where the little demographic information was collected, multiple copies for the Stroop task and the Hayling Test, and a chronometer.

The room located at the Institute of Neurosciences in an experimental room with all white walls, a table with multiple chairs for experiments and a desktop computer. The room itself is isolated and has a door with a lock. In the door, there's a sign indicating people not to bother when the room is being used for experimental procedures.

There's a desktop computer inside the experimental room that's used for data and experiments. The computer has installed a software called Open Sesame 3.2.6 Kafkaesque Koffka that's used for experimental procedures in psychology and neurosciences, it also measures milliseconds. The computer has a good resolution and a keyboard. The experiment

itself was created on that same computer by the principal investigator with the assistance of his thesis advisor.

The sheet of paper for the acquisition of demographical information consisted of a table made on excel. The table was used to collect basic demographic data, assigning the participant's code and then connecting these two with the experimental data. The participants were asked about their age, sex, laterality, and age.

There were 40 copies of each sheet of paper with the correct answers for each condition in the Stroop. The Stroop task itself was used again and again with each participant. The copies were needed for the person assessing it to check if the answer was right or wrong. For the Hayling Test, there were 40 copies made of each part (A and B).

The chronometer was a QUARTZ FREQUENCY: 32768 Hz, and it measures time from milliseconds to minutes.

Stroop task.

The first task they were asked to perform was the Stroop task in Spanish, this task has been used to measure inhibition (Phillips & Bull, 2002; MacLeod, 1992; Vendrell et al., 1995). The task was translated from an English version since it was a really simple translation it was done by the principal investigator. The translations were: from blue to *Azul*, from red to *Rojo*, and from green to *Verde.* There was no need for a certified translator since the translations were so simple and literate. Both the English versions and the translated Spanish ones are attached in the appendix. In all three parts of the task the person assessing it was taking the time with a chronometer and had a sheet with the right answers crossing the

trials that the participant was making mistakes on. The first part was a series of rectangular figures in three different colors: red, blue and green (Figure 1); the participant was asked to say what color he was seeing and to go as fast as possible. The second part consisted of a reading task, in which the participant was presented with a series of words like the second card in Figure 1, which means "red, blue and green" in Spanish, they were asked to go as fast as possible. In the third part, participants were presented with the same words as the second part, but the ink in which the words were written on didn't match the color of the word. For example, the word "blue" was written in red ink, these words were also written in Spanish, like in the other tasks they were asked to go as fast as possible. Each condition had 100 trials, but before the actual task participants were asked to perform 10 "practice" trials.

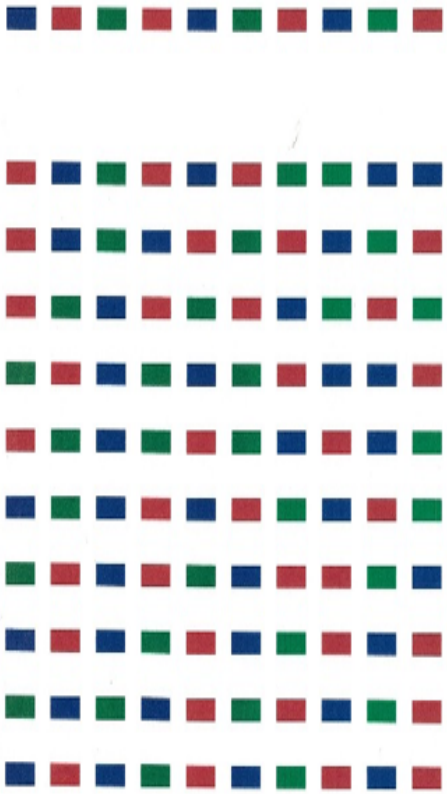

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Figure 1: Stroop task

1.1.1. Hayling test.

The second task was a version standardized in Spain of the Hayling Test, this consisted of two parts: A and B. In part A the participants were presented with 15 simple sentences, in these the final word was missing, and they were asked to complete the sentence with the word that best compliments it. For example, the sentence "the mother takes her kid to the…", participants completed it with words like "school" or "doctor". They were asked to this as fast as they possibly could, and before the 15 official sentences for the task, they had 2 practice trials. On part B of the task, they were presented with similar sentences (simple and missing one word) as part A, only this time they were asked to complete the sentence with a word that had no relationship or connection with the sentences. For example, if they were presented with "the kids go to the park to…" they would have said something like "cat" or "laptop". What they were not asked to say was something that did make sense like in part Alike "play" or "eat". In this part of the task they were also asked to go as fast as possible and had 2 practice sentences. It has been proofed that Hayling parts A and B actually measure different cognitive abilities, one called initiation and the other suppression or inhibition (Nathaniel-James et al., 1997). In the Hayling Test when the person assessing the test finished saying the sentence, the person acquiring the data started the chronometer until the participant said the word that completed the sentence in both parts A and B. Also, the person assessing wrote down the words the participant said in each trial and the reaction time.

Mental chronometry task.

The final task or choice reaction time task was done in a computer inside the same experimental room. There are other inhibition tasks that can be used for this type of experiment such as a stop-signal task (Verbruggen & Logan, 2008). The decision was made to use a choice reaction time task due to Jensen's findings with the same (1979), and others have also used it with the same purpose of measuring inhibition (Kornblum 1965). The task was designed by the principal investigator using the open software Open Sesame 3.2.6 Kafkaesque Koffka. In the task, participants were first presented with clear instructions on how to proceed, after they finished reading them the person assessing the other tasks explained the instructions to them again. Participants were presented with a square and a circle in a random manner, and an X that worked as a distractor between each trial. Every time they saw the square, they had to press the letter C on the keyboard, and every time they saw the circle, they had to press the letter Z. First, the participants were asked to do a series of 10 practice trials to make sure they understood what they had to do. For the first condition of this task, participants were asked to do these 100 times and go as fast as possible. For the second condition participants were doing the same, only this time they didn't have to go as fast as they could. They were told to slow down by the smallest amount that they possibly could, also to slow down every response (i.e. don't just slow down occasionally). It was important that they attempted to slow every response by the minimum amount that they can, otherwise just slowing by a small amount would be interpreted differently by each participant.

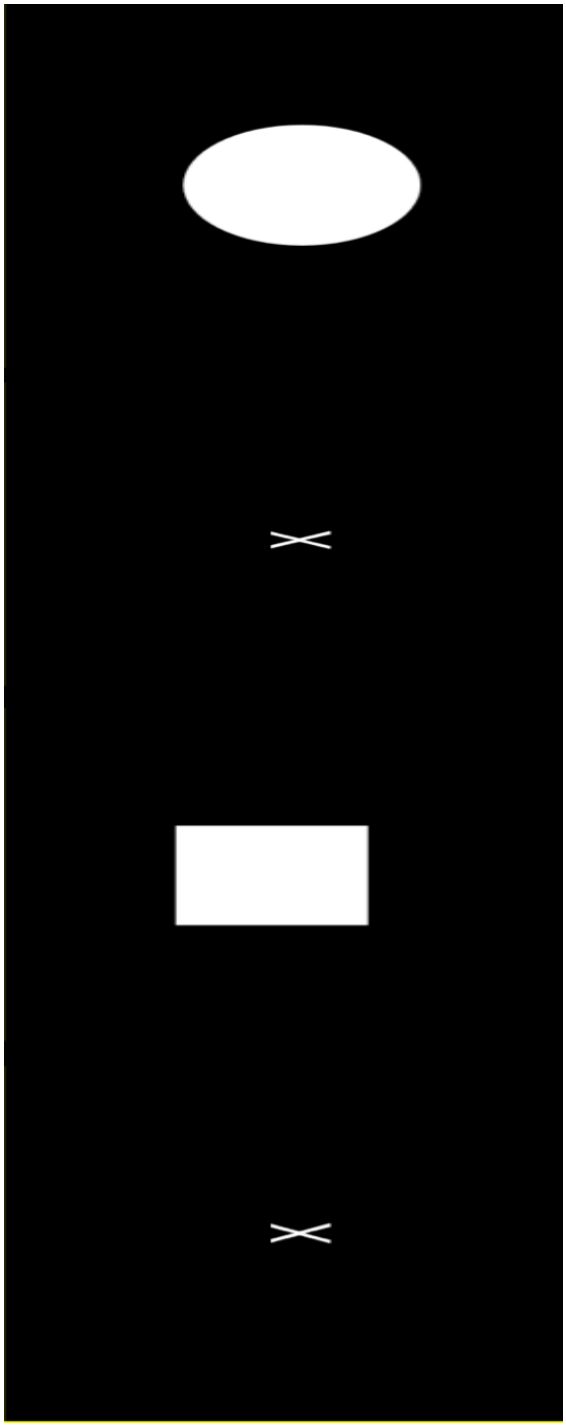

Figure 2: Mental chronometry task

Procedures.

Participants were asked to read and sign the consent form, which included: what they were going to do in the experiment; the fact that they could leave the experiment at any point and not give any explanations; contact information for questions about the experiment; the risk they were taking by participating in such experiment; the fact that it was voluntary and they were not going to receive any monetary or material compensation. A copy of the consent form the participants signed is attached in the appendix. After they signed their participant code was created, it included: the third letter of their first name, the third letter of their last name, the number of the month they were born, and the number of the date of the month they were born. For example, if the participant's name was Nergiz Turgut and her date of birth was November 28, his code would have been: RR1108. After a participant code was assigned to them, they were asked about their age, their sex, and their laterality (if they are right-handed or left-handed). Once this information was collected the person getting the consent explained once more what the experiment consisted of.

Data analysis.

The sample size was calculated using the software G*Power 2.1.9.3 in which: the effect size (ANOVA)=0,20; alfa=0.05; power=0.8; number of groups=1; number of measurements=4; correlation between repeated measurements=0.5; correlation of the no-sphericity=1. The result of the calculation of the sample size was n=36, but it was decided to collect n=40 because there had to be anticipated technical issues or any kind of situation that might be presented with a participant. Two of these situations were, in fact, present during

the study: one of the participants was color blind and another wasn't able to follow instructions.

The raw data acquired from the Stroop task, Hayling Test and Open Sesame was entered into IBM SPSS Version 26 for analysis. Also, the demographic data obtained from the participants was uploaded. Normality testing with Kolmogorov-Smirnov. Spearman correlations were conducted between the Stroop task, Hayling test, and choice reaction time task variables.

Ethical Considerations.

All ethical considerations regarding human subject research were taking into account by submitting a research application to The Institutional Review Board of Universidad San Francisco de Quito. The research application was approved on the 30th day of May of 2019. The letter is attached in the appendix, and it's in Spanish.

Results

Descriptive Statistics.

Table 1 shows demographic data about the participants, tables 2,3, 4,5 and 6 show the mean and standard deviations of each one of the tasks in their reaction times, and their errors

Table 1: Demographic data

	Sex	
	N	**%**
Female	32	80
Male	8	20
	Handiness	

	N	%
Right	36	90
Left	4	10
	Age	
Min	18	
Max	30	
Mean	22.05	
SD	2.64	

Table 2: Reaction times in Stroop task and mental chronometry task

Reaction time					
Stroop Task			**Mental chronometry**		
	Mean	**SD**		**Mean**	**SD**
Color naming	61460.25	11301.55	**As fast as possible**	519.31	159.83
Word reading	44188.5	6394.25	**Smallest delay possible**	998.34	423.24
Interference	104068.28	15775.77			
Speed of processing	52824.37	7123.74			
S3 Interference ratio	1.98	0.34			

Table 3: Errors in Stroop task and mental chronometry task

Errors					
Stroop Task			**Mental chronometry**		
	Mean	**SD**		**Mean**	**SD**

Color naming	0.8	0.96	**As fast as possible**	7.3	6.07
Word reading	0.18	0.44	**Smallest delay possible**	4.08	5.38
Interference	3.55	3.47			

Table 4: Hayling test's means and standard deviations

Condition	Mean	SD
Hayling A (reaction time)	805.13	203.04
Hayling B (accuracy)	3.45	3.90

Before any analysis was conducted on the data, 3 variables were calculated from the existing variables. First, a "Stroop speed of processing" variable was calculated by adding Stroop 1 and Stroop 2 reaction times and dividing that result by 2. Second, a "Stroop interference ratio" variable was created by dividing the Stroop 3 reaction time variable with the previous created Stroop Speed variable. Finally, a "Reaction time ratio" variable was created for the mental chronometry conditions by dividing reaction time of the "smallest delay as possible" mental chronometry task by the "fast as possible" mental chronometry variable. With these, and other variables (which will be explained shortly) the formal statistical analysis was conducted.

Normality testing.

A Kolmogorov-Smirnov test indicated that the reaction times of condition 1 of the mental chronometry task "going as fast as possible" were not normally distributed, D(40)=0.194, p=0.001. Similarly, the same test indicated that the Hayling B accuracy variable was not normally distributed, D(40)=0.245, $p \leq 0.001$. On the other hand, the same test showed that three other variables were normally distributed: the reaction times of condition 2 of the mental chronometry task "smallest delay possible, D(40)=0.99, p=0.200; the Stroop speed of processing variable, D(40)=0.109, p=0.200; and the Stroop interference ratio, D(40)=0.135, p=0.65. Given the not-normally results, the decision was made to run non-parametric testing analysis.

Hypothesis testing.

A Wilcoxon Signed-Ranks Test indicated that the reaction times from the mental chronometry task 2, smallest delay, was statistically significantly higher than the reaction times from the mental chronometry task 1, going as fast as possible, Z=809, $p \leq 0.001$.

The descriptive statistics analysis found that the difference in Standard Deviations from the mental chronometry task 1 and mental chronometry task 2 was *SD=3.* Also, Cohen's d was calculated to measure the effect size between these two variables (d=1.52), indicating that there was, in fact, a large effect size.

A spearman correlation test was conducted to assess the relationship between the inhibition tasks in Stroop and Hayling. The variables compared were Hayling B accuracy and Stroop interference and there was no strong correlation found (r_s = -0.24, n = 40, p= 0.882).

Post-hoc analysis.

A Cronbach's alpha analysis was conducted to assess the internal consistency of Hayling A and Hayling B. Cronbach's alpha for Hayling A and Hayling B items were -0.107 and 0.865, respectively.

Spearman correlations were conducted to analyze the relationship between different variables. First, between the mental chronometry task 1, going as fast as possible, and speed of processing of Stroop no strong correlation was found (r_s = 0.266, n = 40, p= 0.97). Finally, between the mental chronometry task 2, smallest delay, and Hayling B accuracy (r_s = -0.164, n = 40, p= 0.311), and Stroop interference (r_s = -0.218, n = 40, p= 0.176).

Spearman correlations were also used to assess relationship between the number of errors in the mental chronometry task 2, and the Stroop interference task (r_s = 0.137, n = 40, p= 0.399); the two mental chronometry tasks, as fast as possible and small delay, (r_s = 0.732, n = 40, $p \leq 0.001$).

Discussion

Inhibition or speed of processing?

Speed of processing is a cognitive ability that could be defined as the time it takes a person to do a mental task (Salthouse, 1991). After the data acquisition was finished, in the data analysis the effort was made to try and also calculate speed of processing from the existing variables. Many researchers have tried to study speed of processing as an issue, and they have found interesting a relevant result. Salthouse (1991) and Wingfield, Poon, Lombardi & Lowe (1985) found that age was strongly related to speed of processing,

meaning that the older a person gets the slower his speed of processing gets. These findings can't be analyzed in the present study since there's a really limited range of age, and the speed of processing isn't likely to change for just 12 years that are technically in the same developmental phase. Miller (2001) found that people with language impairment had slower speed of processing than those in the control group, these results are also unable to replicate since all of the participants had good language skills. Geary & Brow (1991) and Sheppard & Vernon (2008) measured speed of processing and intelligence, those with really high IQ or "gifted" had a faster speed of processing. Since in the present study there was no intention of measuring IQ and comparing it to inhibition processes is impossible answer this.

A Wilcoxon Signed-Rank Test did indicate that the two measures in the choice reaction time task were significantly different ($p \leq 0.001$), it needs to be implied that these two tasks are measuring different and also there seems to be a problem in the slowing processes. The second condition of this task was not correlated with the other inhibition tasks, so it means that there's a different process taking place. The simplest answer is to infer that there's a speed of processing issue going on. As it was stated before, speed of processing is time, and since participants were given a different but similar instruction thinking about it and knowing what might take more time to process, hence speed of processing issue.

However, since it was stated Hayling and Stroop are reported to measure two different kind of inhibition. This specific task might be measuring a third type of inhibition since it's not correlated to either of them. In this specific experiment is better to speculate that a speed of processing issue is going since the measures are not valid enough to discuss the third type of inhibition point.

Inhibition in Hayling Test and Stroop Task.

Correlations were made between Hayling Test and Stroop Task to assess relationship between their inhibition tasks. The results indicate that they are not correlated (r_s = -0.24), which matches with the literature (Bellevile, Rouleau & Van der Linden, 2006). However, this might have several explanations inside this very experiment. First, and more obvious, Hayling and Stroop appear to measure two different type of inhibition, which might actually mean that the Hayling Test used is appropriate for Ecuadorian subjects. However, the Cronbach's alpha obtained in the analysis for Hayling B (-.0.107) tells a different story. How is it possible that the experiment is able to replicate findings but has no valid measures? This might mean two things: the reports in Bellevile et al., 2006 are not real, or it's just a coincidence that a valid measure and non-valid one are not correlated. The better explanation is that in this experiment these two tasks are not measuring the same because one of them is not valid. Hayling B is not measuring inhibition, any type of inhibition, then it can't be correlated to a task that's actually measuring inhibition(Thorndike, 2015, p.145).

Hayling Test in Spanish Ecuadorian Population.

There seems to be a not so good consistency in the first part of the Hayling Test (Hayling A). In the analysis the Cronbach's alpha for Hayling A was -0.107, which means that the items here are not measuring the same construct, which will be inhibition. The version used of the Hayling Test was one adapted and validated in Spain, which means that there are certain words and cultural references that might not be relevant or familiar for the population studied.

For example, in the item *"En Nochevieja tomamos las…"* most of the participants took a lot of time thinking about a right answer to complete this sentence. This sentence means "In New Year's Eve we drink…", but in Ecuadorian Spanish New Year's Eve doesn't translate to *Nochevieja* but to *Año Viejo.* There's surely an answer that would be easier to complete for people from Spain, but for people from Ecuador it was not so easy. The purpose of using this kind of sentences is that the participant gets used to them and actually tries to inhibit responses in similar sentences in the second part of the task. However, if for participants it's not so easy the first part, then the results from the second part are not so reliable, since they never had the easy-goingness of the part A (Thorndike, 2015, p.165).

The analysis with items from the second part shows a Cronbach's alpha of 0.865 which actually makes sense. In the second part of Hayling participants are supposed to say something that has no sense with the presented sentence. Actually, only repeated sentence in the Spanish version of Hayling is *"En Nochevieja tomamos las…",* and the analysis somehow shows that the data it's still consistent. On the other hand, like it was stated before, if the control condition of the task is not reliable, how is the experimental one is? The first part of the task is supposed to habituate subjects to common sentences with easy answers so that in the second part they use their inhibition and say something that doesn't make sense. Ecuadorian subjects did take longer in the second part than in the first part, however results are not consistent because the test has not been adapted for an Ecuadorian population. The test it's not really measuring what it is supposed to be measuring meaning that before a Hayling test is used in other Ecuadorian

subjects for any type of experiment it should also be validated and have a proper translation with Ecuadorian known words and sentences.

Jensen's Theory.

Jensen (1979) reported in his experiment that the first condition was 8 standard deviations faster than the second condition. In this experiment one of the main intents was to replicate Jensen's findings. In the current experiment the standard deviations between each condition was actually 3. It means that participants were going only 3 times as fast in the first condition comparing it to the second condition. These results might have different explanations. First, participants didn't understand the instructions from the second condition very well. This is very likely, since almost all participants needed further explanation than the one showed in the screen. This might mean that participants were not delaying the responses just a little bit, maybe they were not delaying their responses at al. Another explanation might be that participants were not going as fast as possible in the first condition, which would explain why the standard deviations were as big. These two explanations have further explanations. The participants had already completed two cognitive demanding tasks, which might mean that they were just trying to complete the task and they didn't care if they were following instructions or not. Another explanation would be the main source of the participants, in the majority they were psychology students from an Experimental Psychology course. They were asked by their instruction in the course to participate, which might mean that they were just trying to get their credit hours and not really interested or willing to participate.

Limitations.

There are several limitations with the presented study. First, the participants age ranges from 18 to 30 years. This means that inhibition or speed of processing processes were not being measured in most of the population. This is not a representative sample and the age range is only 12 years, these 12 years are not fixed for a reason, it's just a convenience sample. If the sample was decided to be in this 12-year range for a definite reason, or because the desire was to measure inhibition processes in this particular group it would have been acceptable, however this was not made this way.

Second, even if the Stroop task didn't need an official translation or adaptation since there can't be interpretation in colors, the Hayling test did needed one. Like it was stated before, the used version of the test was adapted in Spain, a totally different culture, with totally different expressions. This test is not really measuring what it is supposed to measure, since it's not a reliable measure in this or any study in the Ecuadorian population. The test should have been translated from English and then validated, or the Spanish version should have been validated. Also, handiness was self-reportable which means is probably not a good set of data and that's why it wasn't used in analysis.

Third, the order in which the tasks were presented to participants should have been different. The participants first did the Stroop, then the Hayling and then the choice reaction time. The choice reaction time task was the main test in this experiment, which means that, probably, it should have been first for it to be more valid. The whole set of tests lasted between 25-30 per participant, which probably means that participants were already tired when they got

to the choice reaction time task. Stroop and Hayling can both be pretty demanding and exhausting, and even worse if one of them demands more than it should have because it was not validated (Thorndike, 2015, p.156).

Finally, a pilot study should have been conducted before beginning the official data recollection. Since the choice reaction time instructions were developed by the team of researchers, those instructions should have been validated first. One of the issues in the data acquisition was that many participants didn't understand the instructions that were shown to them in the screens, or many understood them differently.

Recommendations.

Taking into consideration the several limitations of the study, for a more accurate real set of data the recommendations are as follow: First, make a better definition of the population that is going to be studied. Second, validate any test, questionnaire or survey that's going to be used with that population. Third, if something like handiness is going to be reported or used, it should be drawn with a valid measure. If the data is not going to be used, then why asked participants to report it? Finally, also validate the instructions of those original measures used.

Conclusion.

In conclusion, the present study fails to measure inhibition since it's measures are not valid. The omission of validating the tasks used in the study directly affected the results and validity of the experiment itself. The experiment can be re-done, but all of the recommendations stated before should be taken into account. Even the results that are drawn about inhibition, speed of processing and Jensen's theory should not be taken as valid since the experiment used non-valid measures.

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APPENDIX A: IRB APPLICATION (IN SPANISH)

Comité de Ética de Investigación en Seres Humanos
Universidad San Francisco de Quito
El Comité de Revisión Institucional de la USFQ
The Institutional Review Board of the USFQ

SOLICITUD PARA APROBACIÓN DE UN ESTUDIO DE INVESTIGACION

INSTRUCCIONES:

1. Antes de remitir este formulario al CBE, se debe solicitar vía electrónica un código para incluirlo, a comitebioetica@usfq.edu.ec
2. Enviar solo archivos digitales. Esta solicitud será firmada en su versión final, sea de manera presencial o enviando un documento escaneado.
3. Este documento debe completarse con la información del protocolo del estudio que debe servir al investigador como respaldo.
4. Favor leer cada uno de los parámetros verificando que se ha completado toda la información que se solicita antes de enviarla.

DATOS DE IDENTIFICACIÓN
Título de la Investigación
Inhibición de respuestas intencionales
Investigador Principal *Nombre completo, afiliación institucional y dirección electrónica*
José Nicolás Murgueitio, Universidad San Francisco de Quito, nicolasmurgueitio@hotmail.com
Co-investigadores *Nombres completos, afiliación institucional y dirección electrónica. Especificar si no lo hubiera*
N/A
Persona de contacto *Nombre y datos de contacto incluyendo teléfonos fijo, celular y dirección electrónica*
José Nicolás Murgueitio, +593981494837, nicolasmurgueitio@hotmail.com
Nombre de director de tesis y correo electrónico *Sólo si es que aplica*
Dr. Nergiz Turgut, nturgut@usfq.edu.ec
Fecha de inicio de la investigación *01.06.19*
Fecha de término de la investigación *13.05.20*
Financiamiento *N/A*

DESCRIPCIÓN DEL ESTUDIO
Objetivo General *Se debe responder tres preguntas: qué? cómo? y para qué?*
Identificar el tiempo de inhibición de respuestas intencionales en jóvenes universitarios, mediante un experimento de reacción de tiempo de elección para entender la relación entre intención y acción, y el rol de las funciones ejecutivas. Hipótesis nula: Los participantes se tardaran más en la codicion 2 (ir un poco despacio) ya que la inhibición e intención de respuesta es parte del control ejecutivo y requiere más tiempo de procesamiento.
Objetivos Específicos
● Calcular las diferencias de tiempo en milisegundos entre las diferentes condiciones ● Comparar el tiempo de reacción en las 2 diferentes condiciones (tan rápido como pueda, un poco despacio)

- Identificar el tiempo de reacción en las 2 diferentes condiciones.
- Identificar el rol que tiene la mano dominante (izquierda o derecha) en el tiempo de reacción.

Diseño y Metodología del estudio *Explicar el tipo de estudio (por ejemplo cualitativo, cuantitativo, con enfoque experimental, cuasi-experimental, pre-experimental; estudio descriptivo, transversal, de caso, in-vitro…) Explicar además el universo, la muestra, cómo se la calculó y un breve resumen de cómo se realizará el análisis de los datos, incluyendo las variables primarias y secundarias..*

- Es un estudio cuantitativo, con enfoque experimental de medidas repetidas. Es decir, se aplicará diferentes condiciones (2) al mismo grupo. La primera condición es una prueba de reacción de tiempo de elección. En la segunda condición se aplicará la misma prueba, pero se le pedirá al participante que desacelera un poco la rapidez de su respuesta.
- El resultado de tamaño de muestra es n= 36 personas, se usará una muestra de n=40, porque hay que anticipar problemas técnicos que se den con algún participante, o que algún participante no se presente, etc.
- Criterios de inclusión: Los participantes deben ser jóvenes adultos de 18 a 30 años, de cualquier etnia, sexo, género, orientación sexual, estatus socioeconómico ya que no es necesario leer para la prueba. Deben ser estudiantes universitarios, se asume un nivel de lectura promedio con la única finalidad que puedan leer el FCI.
- Criterios de exclusión: Los participantes no podran tener ningun tipo de discapacidad motora o visual, ya que deben aplastar teclas de computadora constantemente y deben guiarse por claves visuales del monitor.
- El tamaño de muestra se calculó con el software *G*Power 2.1.9.4* en el cuál:el tamaño de efecto (ANOVA) = 0.20; alfa=0.05; poder=0.8; número de grupos=1; número de medidas= 2; correlación entre las medidas repetidas= 0.5; corrección de la no esfericidad= 1
- El análisis estadístico de los datos se realizará en SPSS (Statistical Package for the Social Sciences) , la variable nominal a medir es sexo, las continuas son: la media de tiempo en cada una de las condiciones (2). Se usará ANOVA de medidas repetidas para el análisis estadístico.

Procedimientos *Los pasos a seguir desde el primer contacto con los sujetos participantes, su reclutamiento o contacto con la muestra/datos.*

- Los participantes serán contactados por correo electronico. Se pedirá a algunos profesores de la Universidad que les pidan a sus estudiantes mediante correo electronico o en persona que participen y se contacten con el IP. Los profesores son de varias carreras, conocidos del IP y de la tutora de tesis.
- El estudio se realizará en el Instituto de Neurociencias (D316) del Dr. Graham Pluck, en un ambiente controlado.
- Los participantes leerán el consentimiento informado y después se les preguntará si tienen alguna duda antes de firmarlos (el experimento se ejecutará de manera individual). Se les explicará sus derechos, riesgos y beneficios.
- El experimento consiste en una prueba de tiempo de reacción. Se les pedira a los participantes que cuando vean un circulo aplasten la letra C y cuando vean un cuadrado aplasten la letra Z, ambos con su mano dominante (izquierda derecha). La diferencia entre las dos condiciones es que se les pedira que en la segunda vayan un poco más lento.
- Los participantes leeran el consentimiento y se les recordara que pueden preguntar cualquier cosa del FCI antes y despues de leerlo. Despues de leer el CFI se les explicara paso por paso que pasará en el experimento y se les preguntara si estan de acuerdo, y se les pedirá que por favor firmen el FCI si lo estan.

- Una vez que los participantes firmen el consentimiento, se les explicará brevemente de qué se trata el experimento y se les sentara frente a una computadora para realizar el estudio.
- Una vez finalizadas todas las condiciones del experimento los participantes llenaron un cuestionario demográfico que indicara su sexo, edad y cual es su mano dominante.
  Cuestionario:
  Codigo: Edad: Sexo: Mano dominante:
- Los datos se guardarán en una computadora bajo clave en el laboratorio.
- Una vez finalizada la recolección de datos se procederá al análisis y socialización de los mismos.

Recolección y almacenamiento de los datos *Para garantizar la confidencialidad y privacidad, de quién y dónde se recolectarán datos; almacenamiento de datos—donde y por cuánto tiempo; quienes tendrán acceso a los datos, qué se hará con los datos cuando termine la investigación*

- Los datos serán recolectados en una computadora en el Instituto de Neurociencias que está bajo clave, las personas que tendrán acceso a los datos serán el investigador principal, su tutora de tesis, y el director del laboratorio, ya que los dos últimos ayudaran al investigador principal a analizar los datos una vez que ya esten codificados.
- Los consentimientos informados serán almacenados en el mismo laboratorio.
- Los datos recolectados serán almacenados en el Instituto de Neurociencias bajo la custodia del Investigador Principal y la tutora de tesis, por un mínimo de 5 años como lo establece los reglamientos internacionales.
- Los datos tambien seran almacenados en la computadora del investigador principal para el analisis de datos.

Herramientas y equipos *Incluyendo cuestionarios y bases de datos, descripción de equipos*

- Computadora del laboratorio
- Cuarto controlado
- El experimento elaborado por el investigador principal en Open Sesame (software para crear experimentos para psicología y neurociencias)
- El experimento consiste en una prueba de tiempo de reacción. Se les pedira a los participantes que cuando vean un circulo aplasten la letra C y cuando vean un cuadrado aplasten la letra Z, ambos con su mano dominante (izquierda derecha). La diferencia entre las dos condiciones es que se les pedira que en la segunda vayan un poco más lento.
- SPSS

JUSTIFICACIÓN CIENTÍFICA DEL ESTUDIO

Se debe demostrar con suficiente evidencia por qué es importante este estudio y qué tipo de aporte ofrecerá a la comunidad científica.

La inhibición de respuesta es un proceso cognitivo y cerebral, existen varios tipos de inhibición y el usado en este experimentado será la inhibición a respuestas prepotentes. Según Jahanshahi, Obseso, Rothwell & Obeso (2015) existen varios circuitos neuronales que controlan la inhibición, la ganglia basal y la red fronto-striato-subtalamica-palidal toman un rol esencial en la inhibición habitual selectiva. Ainslie (1975) encontró que la impulsividad es el elegir algo menos recompensante, sobre algo más. Es decir cuando los seres humanos inhiben sus respuestas, están yendo por algo que les causa menos deseo. Floden & Stuss (2006) descubrieron que los lobulos frontales están implicados en el

control ejecutivo, y también implicado en respuestas inhibitorias controladas o intencionales. Lo que quiere decir que la inhibición intencional también está involucrada o relacionada con otros procesos cognitivos superiores. Wylie, Ridderinkhof, Eckerle, & Manning (2007) muestran evidencia que sus pacientes con déficits cognitivos leves tenian tambien insuficiencias en sus respuestas inhibitorias. Estos resultados concuerdan con los de Wylie et al. ya que indican que la inhibición es una función ejecutiva de alto nivel. En cuanto a la intención de respuesta Toni, Thoenissen & Zilles (2001) encontraron que la preparación a un movimiento se basa en circuitos parietofrontales y porciones del giro posteriol temporal, también encontraron que la corteza parietofrontal evalúa los procesos motores antes de realizarlos. Bekkering & Neggers (2002) descubrieron beneficios atencionales en la intención de respuesta los cuales involucran el aumento de orientación visual. El tiempo de reacción ha sido usado desde los principios de la psicología experimental y cognitiva. Este ha sido utilizado para correlacionar con otros procesos mentales y características psicológicas individuales de cada persona. Encontrar las diferencias en el tiempo de reacción es de suma importancia para entender las funciones ejecutivas y control cognitivo. En 1979 Jensen reporta que las respuestas desaceleradas intencionalmente son “8 desviaciones estándar más lentas que las que no lo son”.

Se puede ver que ambos procesos, el de inhibición e intención de respuesta, yacen anatómicamente en diferentes estructuras cerebrales. Sin embargo, ambas redes descubiertas implican alto funcionamiento cognitivo para realizarlas. Por otro lado, el tiempo de reacción ha sido utilizado por varios científicos de la cognición y neurociencia para tratar de medir estos procesos. El objetivo del siguiente estudio es saber exactamente la diferencia de tiempo en milisegundos entre una respuesta inhibida intencionalmente y una que no lo es. El beneficio de este experimento es hacia el conocimientoe exacto de las diferencias en tiempo de la inhibición de respuesta, lo cual puede implicar en el entendimiento de las habilidades cognitivas del ser humano y una evidencia más de que de hecho la inhibición está dentro y forma parte de las funciones ejecutivas de alta función, por ende es parte de estructuras cerebrales sofisticadas. Esto tiene implicación (la inhibición) en muchos trastornos mentales, y puede ser parte de algo netamente instintitvo o aprendido. Este estudio nos acercara a la respuesta, entre mayor la diferencia exista en tiempo entre lo inhibido y lo no-inhibido, es una mayor indicación que es una función cognitiva de superior nivel.

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DESCRIPCIÓN DE LOS ASPECTOS ÉTICOS DEL ESTUDIO
Criterios para la selección de los participantes *Tomando en cuenta los principios de beneficencia, equidad, justicia y respeto*
● Criterios de inclusión: Los participantes deben ser jóvenes adultos de 18 a 30 años, de cualquier etnia, sexo, género, orientación sexual, estatus socioeconómico ya que no es necesario leer para la prueba. Deben ser estudiantes universitarios, se asume un nivel de lectura promedio con la única finalidad que puedan leer el FCI. ● Criterios de exclusión: Los participantes no podran tener ningun tipo de discapacidad motora o visual, ya que deben aplastar teclas de computadora constantemente y deben guiarse por claves visuales del monitor.
Riesgos *Describir los riesgos para los participantes en el estudio, incluyendo riesgos físico, emocionales y psicológicos aunque sean mínimos y cómo se los minimizará*
Los riesgos de este estudio son mínimos debido a que el tiempo de duración de las 4 condiciones del experimento es de aproximadamente 20 minutos. Alguno de los riesgos es que el participante puede sentir fatiga, cansancio y dolor de cabeza luego de participar en el estudio.
Beneficios para los participantes *Incluyendo resultados de exámenes y otros; solo de este estudio y cómo los recibirán*
El estudio abarca estudiantes universitarios, por lo cual el beneficio de involucrarse en esta investigación es conocer más a fondo sobre el método científico, diseño experimental y experimentos cognitivos. El beneficio es garantizado ya que el PI que es quien recolecta los datos, constantemente estará explicando la metodología y los pasos del experimento de su estudio a los participantes, junto a explicaciones de cuál es la razón de hacerlo.
Ventajas potenciales a la sociedad *Incluir solo ventajas que puedan medirse o a lo que se pueda tener acceso*
● Las ventajas son específicas para la sociedad científica en el Ecuador, el incremento de conocimiento empírico y basado en evidencia. ● No existe mucha investigación en el área de psicología cognitiva en el Ecuador, y esta investigación es un aporte directo del país al área de la experimentación cognitiva en general, ya que nunca se han medido exactamente el tiempo de reacción en respuestas intencionalmente inhibidas. Esto es del área de psicología clínica, ayudará a hacer futuras investigaciones sobre salud mental y trastornos que involucren la falta de inhibición como sintomatología, y cuál es el rol de las funciones ejecutivas y las estructuras cerebrales subyacentes en este componente cognitvo.
Derechos y opciones de los participantes del estudio *Incluyendo la opción de no participar o retirarse del estudio a pesar de haber aceptado participar en un inicio.*
● Una vez contactados los participantes tienen la libertad de decir que no quieren participar.

- Antes de firmar el consentimiento informado los participantes tienen la libertad de retirarse.
- Una vez firmado el consentimiento informado los participantes pueden retirarse.
- Una vez comenzado el experimento los participantes tienen la libertad de retirarse.

Seguridad y Confidencialidad de los datos *Describir de manera detallada y explícita como va a proteger los derechos de participantes*

- Los participantes sólo proveerán información demográfica sobre su edad, sexo, y mano dominante (derecha o izquierda). A cada participante se le asignará un código (tercera letra de su primer nombre, junto a la tercera letra de su tercer nombre, el mes de nacimiento, y el día de nacimiento, e.g. SR1015) y no estará conectado ni vinculado de ninguna manera a su nombre u otra información de contacto (número, correo, institución, etc.)
- Los datos serán guardados en todo momento en el Instituto de Neurociencias, tanto durante la recolección, analisis, almacenamiento, publicación y posestudio. La seguridad de los datos se garantiza porque solo el IP, la tutora y el director del laboratorio tienen acceso a estos espacios de la Universidad, serán guardados en un armario con llave.

Consentimiento informado *Quién, cómo y dónde se explicará el formulario/estudio. Ajuntar el formulario o en su defecto el formulario de no aplicación o modificación del formulario*

- El investigador principal explicara el formulario/estudió el día que los participantes se acerquen a realizar el experimento, en el Instituto de Neurociencias (D306).

Responsabilidades del investigador y co-investigadores dentro de este estudio.

Los investigadores tienen la responsabilidad de tratar con respeto a los participantes.

- Los investigadores tienen la responsabilidad de explicar los riesgos a los participantes, y tratar de minimizarlos.
- Los investigadores tienen la responsabilidad de responder cualquier duda que tengan los participantes en cualquier momento del proceso de investigación.
- No romper la confidencialidad.
- No presionar a nadie a participar dentro del estudio.
- Realizar la investigación en el lugar propuesto.
- Ejecutar el experimento de forma ética.
- Aplicar las normas nacionales e internacionales de bioética y ética de la investigación, en todas las fases y actividades del estudio.
- Implementar el estudio según los objetivos, diseño y metodología aprobados por el CEISH-USFQ.
- Notificar al CEISH-USFQ, sobre cualquier desviación, hallazgo o eventos adversos que pudiera darse durante la implementación del estudio y que esté directamente relacionado con él.
- Aplicar procesos de corrección de desviaciones o eventos adversos relacionados directamente con el estudio.
- Diseñar provisiones especiales para atender las necesidades de los participantes.
- Diseñar estrategias para asegurar la comprensión del estudio y del consentimiento informado.

Documentos que se adjuntan a esta solicitud *(ponga una X junto a los documentos que se adjuntan)*

Nombre del documento		Idioma

	Adjunto	Inglés	Español
PARA TODO ESTUDIO			
1. Formulario de Consentimiento Informado (FCI) y/o Solicitud de no aplicación o modificación del FCI *	X		X
2. Formulario de Asentimiento (FAI) *(si aplica y se va a incluir menores de 17 años)*			
3. Herramientas a utilizar *(Título de:: entrevistas, cuestionarios, guías de preg., hojas de recolección de datos, etc)*	X		X
4. Hoja de vida (CV) del investigador principal (IP)	X		X
SOLO PARA ESTUDIOS DE ENSAYO CLÍNICO			
5. Manual del investigador			
6. Brochures			
7. Seguros			
8. Información sobre el patrocinador			
9. Acuerdos de confidencialidad			
10. Otra información relevante al estudio (especificar)			

(*) La solicitud de no aplicación o modificación del FCI por escrito debe estar bien justificada.

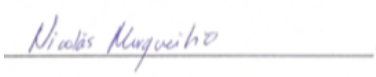
PROVISIONES ESPECIALES
Esta sección debe llenar solo si aplica. En ella se incluyen manejo de población vulnerable y muestras biológicas, manejo de eventos adversos, seguros de incapacidad o muerte, entre otros.
N/A

CRONOGRAMA	**AÑO**							
Descripción de la Actividad (pasos a seguir dentro del proceso de investigación, comenzando por el contacto inicial, reclutamiento de participantes, intervención y/o	**Fechas**	**2019**						
		1	**2**	**3**	**4**	**5**	**6**	**7**

recolección de datos, análisis, publicación…)								
Preparación del experimento con el software Open Sesame en el Instituto de Neurociencias.	Abril	X						
Reclutación de participantes a través de diferentes métodos (correos electrónicos, llamadas, afiches)	Junio	X						
Recolección de datos (ejecución de los experimentos de manera individual) en el Instituto de Neurociencias	Junio - Septiembre	X						
Análisis (SPSS) y socialización de datos	Octubre - Diciembre	X						

CERTIFICACIÓN:

1. Certifico no haber recolectado ningún dato ni haber realizado ninguna intervención con sujetos humanos, muestras o datos. Sí (X) No ( )
2. Certifico que los documentos adjuntos a esta solicitud han sido revisados y aprobados por mi director de tesis. Sí (X) No ( )
   No Aplica ( )



Firma del investigador:
Fecha de envío al Comité de Bioética de la USFQ: 14 de mayo de 2019

APENDIX B: CONSENT FORM (IN SPANISH)

Comité de Ética de Investigación en Seres Humanos
Universidad San Francisco de Quito
El Comité de Revisión Institucional de la USFQ
The Institutional Review Board of the USFQ

Formulario Consentimiento Informado

Título de la investigación: Inhibición de respuestas intencionales
Organización del investigador: Universidad San Francisco de Quito
Nombre del investigador principal: José Nicolás Murgueitio
Datos de localización del investigador principal: jnmurgueitio@estud.usfq.edu.ec

DESCRIPCIÓN DEL ESTUDIO
Introducción
Este formulario incluye un resumen del propósito de este estudio. Usted puede hacer todas las preguntas que quiera para entender claramente su participación y despejar sus dudas. Para participar puede tomarse el tiempo que necesite para consultar con su familia y/o amigos si desea participar o no. Usted ha sido invitado a participar en una investigación sobre Inhibición de respuestas. Para realizar el estudio se requiere la participación de jóvenes adultos de 18 a 30 años de edad. Las personas que participen en este estudio pueden ser de cualquier estatus socio economico, etnia, género, sexo, orientación sexual. Deben ser estudiantes universitarios, y se asume un nivel de lectura suficiente para poder leer este documento. Los participantes no pueden tener discapacidades motoras o visuales ya que estas habilidades son necesarias para llevar acabo el estudio.
Propósito del estudio
La razón para esta investigación es comparar el tiempo de respuestas con respuestas no inhibidas.as respuestas inhibidas es detener voluntariamente una movimiento de la mano. Las respuestas no inhibidas, en este estudio son movimientos con la mano automáticos sin restricciones. Vamos a reclutar aproximadamente 40 participantes con buena salud. Porque el estudio involucra leer instrucciones, y responder según las indicaciones, solamente individuos sin problemas visuales (eg. Cegera) y motores (eg. No poder mover la mano) pueden participar.
Descripción de los procedimientos
El estudio se realizará en el Instituto de Neurociencias (D316) del Dr. Graham Pluck de la Universidad San Francisco de Quito. El estudio durará aproximadamente de 20 a 25 minutos, durante los cuales usted realizará 2 pruebas cognitivas en una computadora del laboratorio. El laboratorio está disponible en el horario de mayor conveniencia para los participantes, y el investigador principal debe acoplarse a estos horarios.

Riesgos y beneficios
El único riesgo es que podría sentirse estresado al completar el experimento. Sin embargo, podría parar en cualquier momento o hacer preguntas. El beneficio para los estudiantes universitarios es poder estar involucrado en una investigación cientifica y conocer los procedimientos metodológicos en un laboratorio. Para la sociedad, la investigación en el area de experimentación cognitiva en el Ecuador no es muy ampla, y existira un incremento en conocimiento empirico y basado en evidencia. Esta investigación es un aporte del país al area de psicología experimental y cognitiva, ya que nunca se ha medido con exactitud lo que se está haciendo en este estudio
Confidencialidad de los datos
Para nosotros es muy importante mantener su privacidad, por lo cual aplicaremos las medidas necesarias para que nadie conozca su identidad ni tenga acceso a sus datos personales: 1) La información que nos proporcione se identificará con un código que reemplazará su nombre y se guardará en un lugar seguro donde sólo el investigador, el director de tesis y director del laboratorio tendrán acceso. 2) Los datos recolectados después del estudio serán almacenados por 5 años, como dictan los reglamientos internacionales de investigación ética en seres humanos. Después de esto se destruiran. Los datos durante este tiempo seran custodiados por el Investigador Principal y su Tutora de Tesis. 2) Su nombre no será mencionado en los reportes o publicaciones. 3) El CEISH-USFQ podrá tener acceso a sus datos en caso de que surgieran problemas en cuanto a la seguridad y confidencialidad de la información o de la ética en el estudio.
Derechos y opciones del participante
Usted puede decidir no participar y si decide no participar solo debe decírselo al investigador principal o a la persona que le explica este documento. Además aunque decida participar puede retirarse del estudio cuando lo desee, sin que ello afecte los beneficios de los que goza en este momento. Usted no recibirá ningún pago ni tendrá que pagar absolutamente nada por participar en este estudio.
Información de contacto
Si usted tiene alguna pregunta sobre el estudio por favor comuníquese con José Nicolás Murgueitio, (jnmurgueitio@estud.usfq.edu.ec) o con Nergiz Turgut (nturgut@usfq.edu.ec)
Si usted tiene preguntas sobre este formulario puede contactar al Dr. Iván Sisa, Presidente del Comité de Ética de Investigación en Seres Humanos de la USFQ, al siguiente correo electrónico: comitebioetica@usfq.edu.ec

Consentimiento informado *(Es responsabilidad del investigador verificar que los participantes tengan un nivel de comprensión lectora adecuado para entender este documento. En caso de que no lo tuvieren el documento debe ser leído y explicado frente a un testigo, que corroborará con su firma que lo que se dice de manera oral es lo mismo que dice el documento escrito)*
Comprendo mi participación en este estudio. Me han explicado los riesgos y beneficios de participar en un lenguaje claro y sencillo. Todas mis preguntas fueron contestadas. Me permitieron contar con tiempo suficiente para tomar la decisión de participar y me entregaron una copia de este formulario de consentimiento informado. Acepto voluntariamente participar en esta investigación.

Firma del participante	Fecha
Firma del testigo *(si aplica)*	Fecha
Nombre del investigador que obtiene el consentimiento informado	
Firma del investigador	Fecha

APPENDIX C: SPANISH HAYLING TEST (PART A)

PARTE A

"*Voy a leer una serie de frases. Quiero que escuche atentamente cada una de las frases, y cuando yo haya terminado de leerlas, usted deberá decirme la palabra que crea que completa mejor la frase y en el menor tiempo posible. Las dos primeras frases son de práctica":*

Práctica 1: Para cerrar la puerta usamos la…

Práctica 2: No puedo recordar su…

		Tiempo de latencia (seg)	Respuesta	Tipo N (XX)
1	La vaca produce una gran cantidad de…			
2	Cuando vio el fuego llamó a los…			
3	Cada mañana, María lleva a su hijo al…			
4	Las abejas producen…			
5	Se colocó la corbata alrededor de su…			
6	Miramos la hora en el…			
7	En Nochevieja tomamos las…			

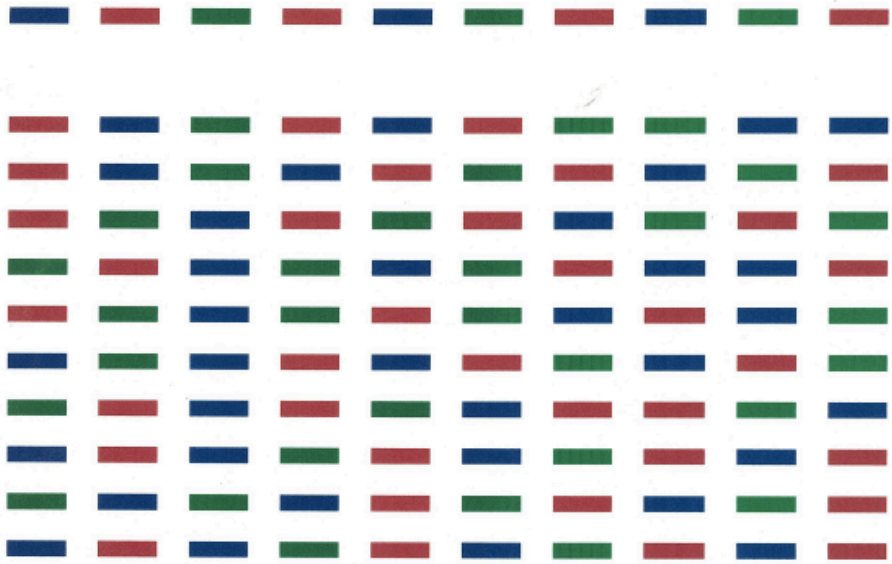
8	Ella fue a la peluquería para teñirse el…			
9	El ladrón fue condenado a pasar muchos años en la…			
10	El árbitro dio por finalizado el…			
11	Para enviar una carta hay que ponerle un…			
12	Las películas se estrenan en el…			
13	Antes de dormir apagamos la…			
14	Al pan, pan, y al vino…			
15	Tres personas resultaron gravemente heridas en un…			

APPENDIX D: SPANISH HAYLING TEST (PART B)

PARTE B *"Ahora voy a seguir leyendo frases similares a las anteriores en que falta la última palabra. Sin embargo, esta vez usted debe completar la frase con una palabra que no tenga ningún sentido en el contexto de la frase. La palabra que diga usted no debe estar relacionada con la frase en ninguno de sus sentidos. Las dos primeras frases son de práctica".* Práctica 1: El jugador marcó un gol en el último… Práctica 2: El escritor acaba de publicar su última…				
1	Comemos la sopa con la…			
2	Para clavar un clavo se utiliza un…			
3	Este verano ha hecho mucho…			
4	En el primer renglón escriba su…			
5	En otoño los árboles pierden sus…			

6	La gallina pone…			
7	El médico le diagnosticó una grave…			
8	El periquito es un tipo de…			
9	Los niños fueron al parque a…			
10	Los católicos van a misa los…			
11	Es duro reconocer cuando uno se…			
12	Para cortar usamos un…			
13	Se acabó toda la comida porque tenía mucha…			
14	En Nochevieja tomamos las…			
15	El cliente le dio al camarero una buena…			

APPENDIX E: STROOP COLOR NAMING TASK AND ANSWERS



SUBJECT CODE

Stroop Colour-Word Test
Card 1- Colour Naming

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NUMERO DE CORRECTAS:
NUMERO DE INCORRECTAS:
TIEMPO:

APPENDIX F: STROOP WORD READING TASK AND ANSWERS

AZUL ROJO VERDE ROJO AZUL VERDE ROJO AZUL VERDE ROJO

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SUBJECT CODE

Stroop Colour-Word Test
Card 2- Word Reading (black and white)

ROJO AZUL ROJO VERDE AZUL ROJO VERDE AZUL ROJO AZUL
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APPENDIX G: STROOP INTERFERENCE TASK AND ANSWERS

ROJO VERDE AZUL VERDE ROJO AZUL AZUL VERDE ROJO VERDE

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SUBJECT CODE

Stroop Colour-Word Test
Card 3- Colour Naming (Interference)

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