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(RESEARCH ARTICLE)

Effects of Koutoukou (local artisanal liquor) on selective attention in young people in school settings (Côte d'Ivoire)

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Abstract

Introduction: Alcoholism is one of the most significant health risks worldwide. Côte d'Ivoire, which has been in economic crisis since the 1980s, compounded by a political crisis, is no exception to this scourge. It is increasingly common to see students drinking alcohol in bars located dangerously close to schools, amid general indifference. They are increasingly turning to inexpensive alcoholic beverages such as Koutoukou (traditional, artisanal brandy), which contains several other alcohols that are potentially harmful to health in addition to the ethanol common to all alcoholic beverages.

Objective: The aim of this study is to assess the effects of Koutoukou consumption on the selective attention of young learners.

Methods: The attentional abilities of 111 adolescents and young adults (schoolchildren and students) who consume this beverage were assessed using the Stroop test after a blood alcohol level of 0.8 g/l was induced.

Results and conclusion: The results show that koutoukou (KTK) causes very significant disturbances in the selective attention of regular consumers (RC) regardless of the period of alcohol consumption (before or after drinking). However, occasional consumers (OC) showed a significant decline in this cognitive function only 30 minutes after drinking.

Keywords: Alcohol; Koutoukou Consumption; Young Learners; Selective Attention; Cognition

1. Introduction

The effects of alcohol consumption are a real public health problem. Alcohol abuse or harmful use is a well-known risk factor for disability and premature mortality ([1] Maleki et al., 2024). This product is considered the third leading risk factor for mortality, after high blood pressure and tobacco. Alcohol abuse kills 3 million people each year and accounts for more than 5% of the global burden of disease. Approximately 400 million people, or 7% of the global population aged 15 and older, suffer from alcohol-related disorders. Among them, 209 million people (3.7% of the global adult population) are alcohol dependent. In addition to deaths and health damage, alcohol consumption causes social problems ([2] WHO, 2018). The use of this substance by adolescents and young adults varies considerably between countries and cultures, and between different population groups within a country ([3] Ahlström et al., 2005). In Côte

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d'Ivoire, it is becoming increasingly common to see young people drinking alcohol in bars located dangerously close to schools, amid general indifference [4] (Diboh, 2014).

In Côte d'Ivoire, rural populations and those living in densely populated urban areas often use traditional (artisanal) methods of alcohol production. This is why koutoukou, the subject of our study, occupies a prominent place in the drinking habits of Ivorians. It is produced by distilling the fermented sap of oil palms (*Elaeis guineensis* Jacq). In addition to the ethanol common to all alcoholic beverages, this drink contains methanol, propanol, butanol, and other higher alcohols ([5] Camara et al., 2008). These alcohols are unfit for consumption and dangerous to health ([6] Pohanka et al., 2016). Surveys conducted in Côte d'Ivoire by [7] Diboh et al., (2013) reveal that, for economic reasons, young people are consuming more and more koutoukou. As the central nervous system of adolescents and young adults is still developing, we set out to determine the possible consequences of consuming this artisanal liquor on certain cognitive abilities, particularly selective attention.

2. Subject, Materials, and Methodology

2.1. Study Setting and Population

The study was conducted at the Neuroscience Laboratory of Félix Houphouët Boigny University in Abidjan (Ivory Coast), in a room isolated from any external influence, during the period from February 2024 to May 2024. Pupils and students (n=111, average age 20.8±3.4 and average weight 62.1±6.3) from eight schools in three districts of the city of Abidjan (Cocody, Abobo, and Yopougon) were selected after a preliminary survey to determine their level of alcohol consumption, mainly koutoukou. Three (3) groups of subjects were formed, including two (2) experimental groups (n=37 each) and one control group (n=37). Individuals who consumed less than or equal to (≤) four drinks per month and no more than four standard drinks on a single occasion were placed in the occasional consumers (OC) group. Those who reported consuming five or more drinks per week were classified as regular consumers (RC) of this beverage ([8] Cahalan and Cisin, 1968; [4] Diboh, 2014).

The participants were non-alcohol dependent, male, and sober for at least 24 hours (h). They were selected after verification of their medical history and health status. To this end, the heart and liver status of the selected individuals was assessed by measuring blood transaminase levels. Individuals with alcohol hypersensitivity, metabolic or cognitive disorders, and color blindness were excluded.

2.2. Equipment

The equipment used consisted mainly of:

- A bathroom scale;
- A gay lussac centesimal alcoholometer used to measure alcohol content;
- A graduated test tube used to measure the quantity of koutoukou;
- A drinking glass;
- Koutoukou;
- An electronic blood pressure monitor with cuff for measuring (monitoring) blood pressure and pulse;
- A stroop test for assessing selective attention (see appendix);

2.3. Methods

2.3.1. Preparation and consumption of alcohol

On the day of the test, participants were required to have been sober for at least 24 hours and to have fasted for at least 8 hours to allow for rapid alcohol absorption ([9] Haber et al., 1996; Son et al., 2021[10]). The alcohol content of the solution was determined using a Gay-Lussac alcoholometer. To do this, the alcoholometer was immersed in the solution and the alcohol content was read directly on the graduated rod.

The body weight of the subjects is determined using a weighing scale. This, together with the alcohol content, was used to determine the volume of koutoukou to be ingested by the subject in order to obtain an approximate blood alcohol level of 0.8 g/l, based on the WIDMARK formula ([11] Widmark, 1992). This formula takes into account the weight and sex (male or female) of the subject.

Thus, let A be the approximate blood alcohol level and k the alcohol diffusion coefficient (0.7 for men and 0.6 for women); the density of ethanol being approximately 0.8, the formula is as follows:

$$A = \frac{V \times p \times 0{,}8}{k \times m}$$

where

$$V = \frac{A \times k \times m}{p \times 0{,}8}$$

- A = being the Approximate Blood Alcohol Concentration (desired blood alcohol concentration)
- V = corresponds to the volume (in ml) of alcohol to be ingested by the individual
- m = mass of the individual in kg
- k = diffusion coefficient (K = 0.7 for men and k = 0.6 for women)
- p = degree (percentage) of alcohol in the drink to be consumed
- 0.8 = density of ethanol.

The desired blood alcohol level being 0.8 g/l, the volume of alcohol to be ingested is:

$$V = \frac{0{,}8 \times k \times m}{p \times 0{,}8}$$

2.3.2. Assessment of selective attention in subjects under the influence of koutoukou (KTK)

Selective attention was assessed using the Stroop test. This test consists of three boards (see appendix):

plate 1 contains rectangles of different colors (green, red, yellow, and blue);

plate 2 consists of color names written in black ink;

and board 3 contains color names written in ink of different colors or not.

Each board has 10 lines of 5 words or colored rectangles. They are presented to the subject in succession.

The test began with board 1. On this board are rectangles of four different colors: green, red, yellow, and blue. The subject was instructed to name the color of each rectangle as quickly as possible, audibly, from left to right, moving to the next line at the end of each line. Once at the end of the page, they started again until the allotted time (45 seconds) had elapsed.

Plate 2 contained the names of four different colors written in black ink: green, red, yellow, and blue. The subject was instructed to read these words aloud as quickly as possible, moving from left to right, line by line, as in step 1.

Plate 3, which puts the subject in a situation of interference, contains color names written in ink of different colors or not. The instruction was not to read the word, but rather to name the color in which the word is written as quickly as possible.

Each time an error was detected (reading or naming error), it was immediately pointed out so that the subject could correct it.

An initial assessment was carried out before alcohol consumption. After this stage, the experimental subjects (CO and CR) had 3 minutes to consume a quantity of Koutoukou equivalent to a blood alcohol level of approximately 0.8 g/l. Sequences measuring attention and memory abilities were carried out under the same conditions as before alcohol consumption, for the experimental delays (every 15 minutes during the 90 minutes following alcohol consumption). The control subjects (n=37) participated in the same tests, with the only difference being that they did not consume alcohol.

The tests are conducted in the morning (9 a.m.) to minimize the effects of fatigue (physical and mental).

2.4. Data collection

Stoop test: For each trial, the number of words read or colors named during the 45-second time limit is counted. The value taken into account is the score (number of words or colors named) achieved for each trial.

2.5. Variables

There were two types of variables in this study:

- Classification variables, which are consumer categories (CO; CR);
- Dependent variables, which are the scores for the different trials in the Stroop test.

Free consent: The informed consent of each participant was obtained in advance.

2.6. Statistical data processing

The data collected were processed using STATISTICA® 10.0 software. For each series of experiments, the three groups of subjects were compared: control subjects, occasional Koutoukou consumers (OC), and regular Koutoukou consumers (RC). The aim was to analyze the overall attentional and memory performance of each group and then compare them with the other groups. It was therefore necessary to verify the significance of the probable differences observed between the averages of the measurements obtained in each group and at different periods of alcohol consumption. In other words, the aim is to determine whether, at each stage of alcohol consumption, the difference in performance values between the groups is significant or not. To do this, an analysis of variance (ANOVA) was used to make these comparisons every 15 minutes. A probability (p) of 0.05 is considered the threshold for significance. Thus, if "p" is less than or equal to 0.05, then the difference between the variable s compared is significant. On the other hand, if "p" is greater than 0.05, then the difference between the two variables compared is not significant.

3. Results

3.1. Evaluation of the selective attention of subjects under the influence of koutoukou

3.1.1.) Evaluation of the attentional performance of the three groups of subjects according to the period of alcohol consumption, during the first administration of the Stroop test (colored rectangles)

- Before alcohol consumption

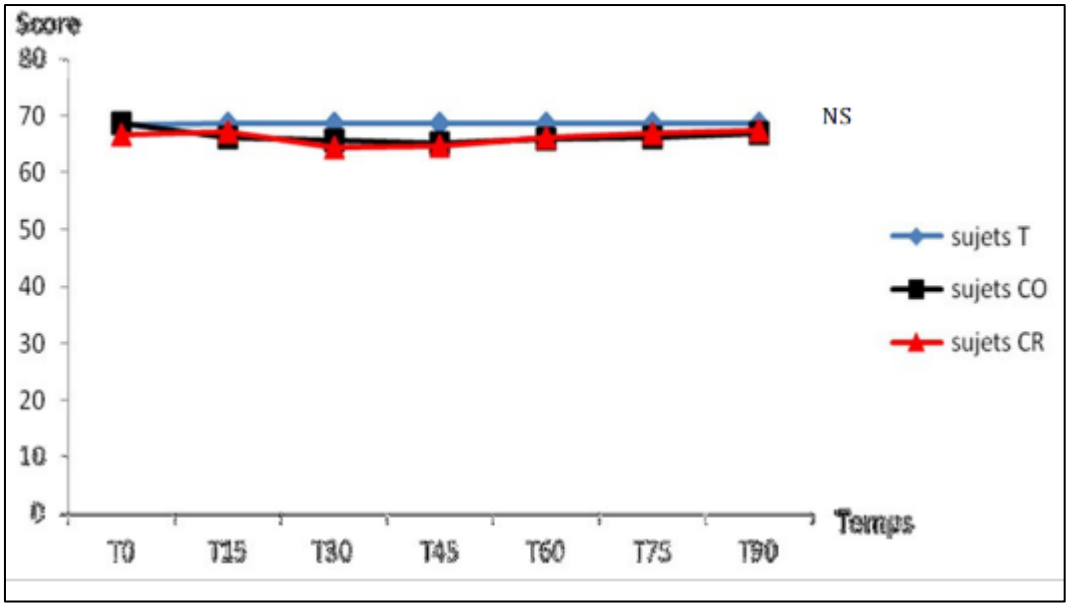
Before alcohol consumption, the performance of the control subjects (T) and that of the occasional koutoukou consumers (CO) were identical (68.6±2.1). The performance of the CR subjects was 66.57±1.7 (Figure 1). The comparison between CR and control subjects gives $F(1.41)=0.20$ for $p=0.65$; the difference is therefore not significant.

- After alcohol consumption

Fifteen minutes after alcohol consumption, the comparison of performance between T subjects and CO subjects gives $F(1,34)=0.32$ and $p=0.57$. The difference is not significant. Similarly, the difference in performance between the controls and the CR subjects is also not significant, as $F(1,41)=0.11$ and $p=0.74$. Likewise, there is no significant difference between the two experimental groups (CO and CR), as $F(1,37)=0.03$ and $p=0.85$.

Thirty minutes after consuming the traditional beverage, the experimental subjects recorded their lowest scores in this test. However, the differences observed between the performance of the control subjects and that of the test subjects (CO and CR) were not statistically significant. Indeed, the comparison between T and CO subjects gives $F(1.34)=0.62$ and $p=0.43$, while the comparison between controls and regular Koutoukou consumers gives $F(1.41)=0.93$ and $p=0.34$. The two experimental groups had almost identical performances. The comparison gives $F(1.37)=0.067$ for $p=0.79$: the difference is therefore not significant.

The same observations were made during the other periods in which the tests were carried out: forty-five, sixty, seventy-five, and ninety minutes after alcohol consumption.



NS: not significant

Figure 1 Performance of the three groups of subjects on the Stroop test according to the period of alcohol consumption during test 1 (colored rectangles)

There are no significant differences between the performances of the different groups in test 1 of the Stroop test.

3.1.2. Evaluation of the attentional performance of the three groups of subjects according to the period of alcohol consumption during test 2 of the Stroop test (black words)

Figure 2 shows that the number of words read did not vary significantly according to the type of subject tested or the period (before and after alcohol consumption). In other words, before alcohol consumption, the performance of the control subjects and that of the two test groups was identical. The same was true after consuming Koutoukou. All inter-group and intra-group comparisons yielded no statistically significant results (p> 0.05)

3.1.3. Evaluation of the attentional performance of the three groups of subjects according to the period of alcohol consumption, during test 3 of the Stroop test (colored words)

- Before alcohol consumption

Before ingesting the traditional beverage, the performance of the controls and that of the CO subjects was identical (Figure 3). However, the performance of the CR subjects in this word color designation test was lower than that of the controls.

Nevertheless, this difference is not statistically significant because F(1,41)=0.88 and p=0.36.

- After alcohol consumption

Fifteen minutes after alcohol consumption, a comparison of performance between controls and CO subjects reveals no significant difference [F(1,34)= 0.18; p=0.67]. Similarly, the performance of controls and CR subjects was not significantly different [F(1,41) =1.40; p=0.24]. The same was true for performance between the two groups of experimental subjects [F(1,37)= 0.82; p=0.37].

From the 30th minute after alcohol consumption until the end of the experiment, Figure 3 shows that the attentional performance of the CR subjects differed significantly from that of the controls, but also from that of the CO subjects; the statistical analysis gave values of $p<0.05$ for all other periods of alcohol consumption.

It should also be noted that the performance of the CO subjects at T30 was significantly lower than that of the control subjects (F (1,34)=0.61; p=0.045). However, from T45 to T90, the performance of these two groups remained similar (p>0.05).

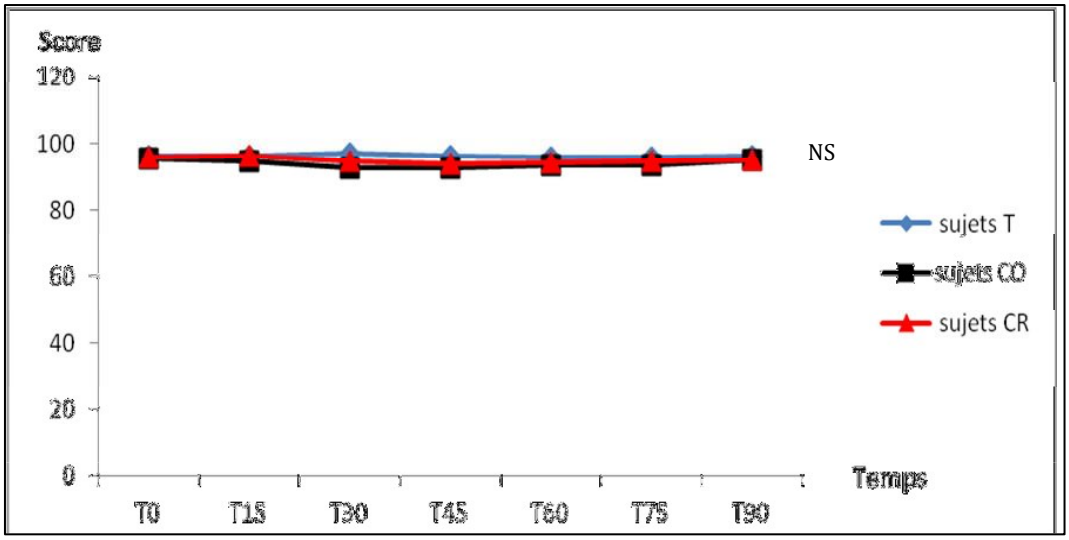
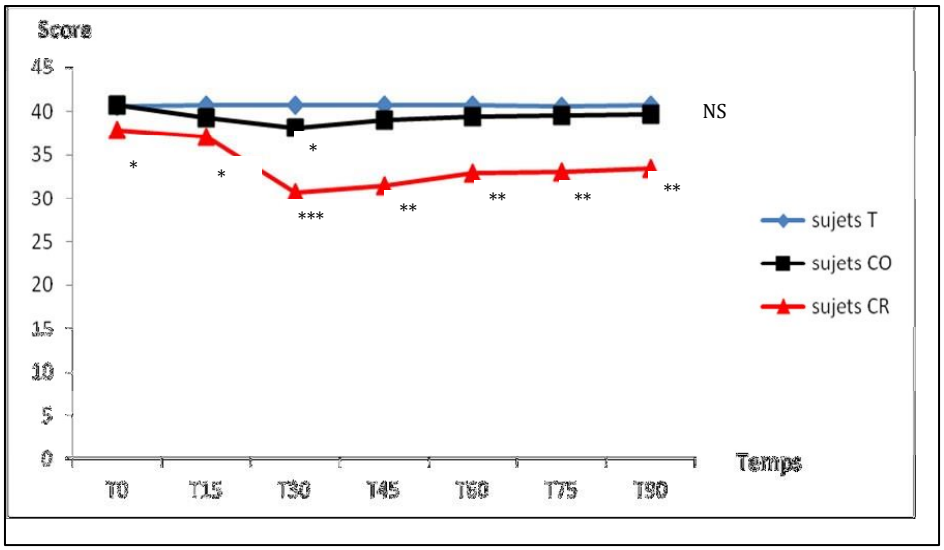


Figure 2 Performance of the three groups of subjects on the Stroop test according to the period of alcohol consumption during test 2 (words in black)

There were no significant differences between the performances of the different groups in test 2 of the Stroop test.



*: Significant; **: highly significant; ***: highly significant

Figure 3 Performance of the three groups of subjects on the Stroop test according to the period of alcohol consumption during test 3 (colored words)

From the 30th minute after alcohol consumption until the end of the experiment, the attentional performance of the CR subjects differed very significantly from that of the controls, but also from that of the CO subjects. The latter two (T and CO) had relatively similar performance (not significantly different) before and after the ^{30th}minute.

4. Discussion

In this study, we set out to evaluate the effects of a blood alcohol level of 0.8 grams per liter of Koutoukou on the selective attention of students. This dose corresponds to the threshold for acute intoxication ([12] Parker et al., 2008).

To this end, the Stroop test and the WAIS III test were used. The results show that the attentional performance of the control subjects and the test subjects did not differ significantly during the presentation of the first two boards of the Stroop test (board for naming colored rectangles and board for reading neutral color names), regardless of the period of alcohol consumption. These first two boards constitute the conditioning phase, in preparation for the third board,

known as the incongruent board, which consists of color names written using different ink colors ([13] Lemercier, 2002). The latter requires more complex cognitive processing with inhibition of certain tasks. Selective attention models consider that selective information processing has two aspects: on the one hand, the selection of target information and, on the other hand, the active inhibition of distracting information [14] (Morton and Chambers, 1973; [15] Cohen et al., 1990). However, when distracting information is processed automatically (reading words), it interferes with the controlled processing of target information (color). In order to respond correctly to the task instructions, the subject must then actively inhibit its processing. Our work shows that koutoukou significantly disrupts this inhibition process in regular consumers of this beverage. The performance of the latter (CR) in this test declines significantly compared to the control group and the CO subjects from the 30th minute after alcohol consumption until the end of the experiment (90 minutes after alcohol consumption). The work of [16] Ben Amar (2007); Apfelbaum et al., (2009)[17] show that alcohol reaches its maximum diffusion between thirty minutes and one hour. However, our study indicates that this maximum is reached in all test subjects at thirty minutes. The current study does not allow us to know whether this rapid absorption is due to the subjects surveyed, whose average age is 20, and/or the type of alcohol consumed. Indeed, artisanal Koutoukou is known to be particularly harmful due to its chemical composition. In addition to the ethanol common to all alcoholic beverages, it contains methanol, propanol, butanol, and many other unidentified compounds ([18] Hamon and Camara, 2000). Some authors have also highlighted the harmful effects of acute consumption of 125 ml of this substance on alertness levels in adult men ([18] Yao et al., 2012), as well as in schoolchildren ([20] Diboh et al. 2015). In addition, the disruption of certain cognitive functions caused by drinking this beverage lasts longer than that caused by other industrial liquors ([21] Yao et al. 2011).

The toxic effects of alcohol on the brain have been demonstrated by medical imaging: in particular, a decrease in gray matter has been observed in people with alcohol dependence. The earlier alcohol consumption began, the greater the alteration in gray matter [22] (Chanraud et al., 2006; Inserm, 2006 [23]).

Our work also shows that the selective attention of COs was only significantly impaired 30 minutes (T30) after the blood alcohol level reached 0.8 g/l of koutoukou. Thus, moderate consumption of this traditional liquor does not appear to have any significant deleterious effects on this cognitive function in young people. These results are consistent with numerous data in the literature ([24]Peter et al. 2022; [25] Kouadio et al. 2025; [26] Diboh et al. 2025), which recommends moderate alcohol consumption, if not abstinence. However, some authors claim that alcohol, even in small doses, causes concentration difficulties ([27] Ballway et al., 2021).

5. Conclusion

In this study, we set out to evaluate the selective attention of young learners who consume koutoukou in Côte d'Ivoire. To this end, our work reveals that selective attention is significantly impaired in regular koutoukou consumers (RC) regardless of the period of alcohol consumption (before or after drinking). However, occasional consumers (OC) showed a significant decline in this cognitive function only 30 minutes after drinking; the rest of the time, their performance was similar to that of the control subjects.

Furthermore, the low cost of producing and selling koutoukou poses an additional danger. It should be noted that these results were obtained with an induced blood alcohol level of 0.8 g/l, which is the threshold for acute intoxication. In reality, as consumption levels are generally well above this, this research highlights the extent of the danger facing our country's youth.

Recommendations

Koutoukou alcohol consumption does not seem to be on the decline, with growing poverty resulting from the socio-political difficulties facing Côte d'Ivoire. The alarm must be sounded through the wide dissemination of this research on koutoukou in order to raise awareness among all segments of the population. It would also be wise to regulate the production of koutoukou, provide technical assistance and state subsidies in order to obtain a higher quality alcoholic beverage, the danger of which would lie solely in its abuse. We therefore recommend tightening the law against the sale and consumption of alcohol by minors. Given that the human brain continues to develop until adulthood and reaches its peak capacity at the age of 22/25, the recognized toxicity of this beverage could seriously hinder the development of this essential organ.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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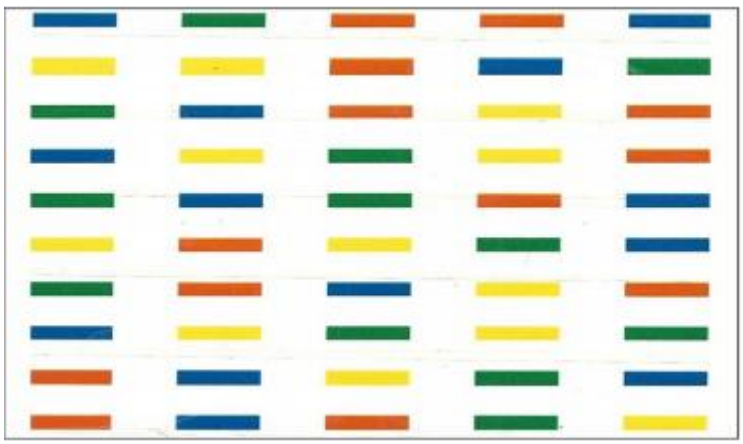
Appendix: STROOP test

STROOP : PLATE 1



STROOP : PLATE 2

STROOP : PLATE 3