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Researches and Application of the Emotional Stroop Effect in Clinical Psychology

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Abstract

As far as we know, Stroop effect was discovered by a American Psychologist named John Riddley Stroop with a definition of interference between the color and the meaning of the same stimulus. It has been make good use in many fields, especially in clinical psychology. Emotional stroop effect which became the highlight during the past two decades. So its main researches and focus will be showed in details here, such as, social phobia, anxiety & anxiety disorders, alcohol dependence, heroin, gambling, and compulsive disorders. Besides, clinical evidences and academic explanations are also concluded. Then the future of this study would be discussed in the end.

Keywords: Research, Application, The emotional stroop effect, Clinical psychology

Emotion plays an important role in every day life. The meaning of emotions is the attitude experience and relative behavioral reflections towards impersonal objects. It interacts with our cognitive system, and impacts our behavior consequently. On the contrary, through operating experiments to emotion, we could acquire a series of data about the internal relationship between emotion and cognitive system to some extent, then speculate how they function to each other. So, what are the reason and the academic mechanism of emotion stroop effect? How do we take them into applicative practice? Have it got a further future in study? All of those would be content in this paper.

1. Traditional Stroop Paradigm & Emotional Stroop Paradigm

1.1 traditional Stoop paradigm

In the color-naming experiment of John Riddley Stroop's traditional Stroop effect, operators show the words with different colors one by one. Subjects are asked to speak out the color of each word quickly and accurately, without paying attention to the meaning of those words. It contains two experimental conditions, that is, color word interferential condition and control condition. Under the condition of color word interference, subjects are given different color word, whose meaning is also different from its color, for example, "green" is written in red, see Figure 1. While in condition of control, we show non-color word or non-word character with different colors, for instant, red "good" or green "xxxxx". The result of this kind of task is that the reflection time of control would be shorter than it under condition of color word interference. The differentia between those two reflection times is Stroop Effect.

Traditional Stroop Effect has lots of explanations. The most popular one is automatic theory, which maintains that reading is the high-automatic process ability, while color-naming is not. Being faced with literature materials, it's difficult to avoid processing semantic meaning, not only paying attention to the color of word, but noticing its meaning. As a result, Stroop effect is the interference of processing semantic meaning to color-naming (Yang & Luo, 2004).

1.2 emotional Stroop paradigm

Based on the traditional paradigm, scientists expect emotion could impact the color-naming. Emotional Stroop paradigm usually gives words with different colors (neutral words and emotional words), requiring subjects to overlook meanings of words and name the color as soon as possible.

The characteristic of this paradigm is, firstly, although it changed the words into emotional words and non-emotional words, the task for subjects keep the same as traditional one; secondly, subjects need to divided into groups depending on some characteristic of emotion, and this kind of emotion consistent or inconsistent or opposite with the emotion reflected by words in experiment. When in consistent situation, the reflection time would slower than neutral condition, showing the interference effect of emotional consistency.

2. Application of Emotional Stroop Effect in Clinical Psychology

2.1 Social Phobia

Hope, Rapee, Heimber & Dombeck (Nader Amir etc., 1996) (1990)found that, because of unbalanced phobia, patients of

social phobia have longer reflection time to words related with social threaten, comparing with normal words. Mattia, Heimberg and Hope (Nader Amir etc., 1996) (1993)repeated the experiment above, and proved that, the group which in therapy (cognitive-behavior therapy or medicine of anti- dysthymic) didn't appear the phenomenon of interference with social threaten words. Moreover, Mathews and Sebastian (Nader Amir etc., 1996) (1993) could not found the interference effect among the university students who have high level anxiety of snake. However, it still had many suspect questions, such as, no contrast of high anxiety and low anxiety, wrongly expectation of restraining the information related to threaten in patients.

Later, Nader Amir etc. (Nader Amir etc., 1996) improved the Mathews etc.'s experiment. First of all, according to the diagnoses of social phobia in DSM—R (American Psychiatric Associates, 1987) to select subjects in experiment, not using the students scared snake before. Besides, it controlled the different situation between group high anxiety and group low anxiety in Stroop task. They supposed if Stroop was affected by level of anxiety, then the social phobia patients should show the interference to social threaten words. Experimental words divided into several groups, social threaten level, neutral level related with social threaten, physical (body) threaten level, neutral level related with physical (body) threaten. All the neutral words had been considered its letter, the number of byte, and the frequency in English (Carroll, Davies & Richman, 1971). The level of color included red, black, and blue, orange, green. Apart from this, scientist also used STAI-Sto measure the anxiety operation effect of patients.

The result shows that, 2(Group: social phobia, control)×2(time: before, after)repeated ANOVA analysis indicated the significant interaction between group and time; the simple main effect showed the STAI-S score of social phobia patients being higer than group of control, no matter before or after the anxiety operation. It could be seen that operation increased anxiety, but only functioned in group of social phobia. After that, they put 2(group: social phobia, control)×2(type of words: social, physical)×2(threaten: threaten, neutral)×2(level of anxiety: high, low)into multiple repeated ANOVA analysis, and result showed that, main effect of anxiety was significant in type of words× threaten× level of anxiety, while neutral words only had main effect to anxiety. Meanwhile, they found social phobia patients acted much more quickly in high anxiety condition; comparing with physical words, the reflection time of social threaten words was obviously faster. On the other hand in group of control, 2×2×2 repeated ANOVA analysis show neither any significant difference, nor any significant simple main effect (Nader Amir etc., 1996).Their experiment offered a good base to test the anxiety level among social phobia patients , proving that social phobia patients were sensitive to words related to social characteristic, and easier to become anxiety than common people.

2.2 Anxiety & Anxiety Disorder

Emotional Stroop Effect is used in the experiment to assess anxiety, one of the most research fields. Using the traditional Stroop paradigm (1935),Bower (1981) set up a model, which could predict the increase of some emotion (such as anxiety) (Boris & Michacl, 2001). According to Bower's theory, we could suppose that the Trait Anxiety (TA) is correlative to the State Anxiety (SA). In experiment of Boris Egloff and Michael Hock (2000), it tested the stimulate processing difference related to threaten in emotional Stroop effect, whether being impacted by the main effect of TA, or whether being different among subjects of anxiety in main effect of SA (ignoring the personal characteristic of subjects) (Boris & Michacl, 2001).

Boris (2000) selected 120 university students to be subjects, using the Mean of the State Trait Anxiety Inventory (STAI, 1981) to measure TA. In experiment, it got 4 kinds of cards, two are neutral and two others are threaten (had considered the length and frequency), which included one for physical threaten words (such as, war or death) and the other for self threaten words (like, failure, mistake). A set of cards were divided into 4 batches from 46 words in total. The color of each batch is one of these colors (green, red, yellow, blue) (Boris & Michacl, 2001).

Result of Boris etc.(2000)is below,through the multiple regression analysis of the interaction of SA and TA in Stroop interference, score of TA was divided high TA, medium TA and low TA, while only group high TA got the positive correlative with SA in Stroop interference . Comparing with it, low TA got the negative correlative with SA. At the same time, regression analysis also show the significant interaction of SA×TA, that is, TA was play a role of alleviant between SA and direction of attention (Boris & Michacl, 2001). Therefore, Trait Anxiety (TA) is just a represent of alleviant to State Anxiety (SA), while it functioned to each other as well.

Many researches on patients with anxiety disorder also developed. One of them is TU, Dresden (1999) study on anxiety disorder patients. Subjects in experiment are patients with generalized anxiety disorder (GAD), social phobia patients (SP), and group of control. Displayed words were anxiety words, speech words, neutral words, positive words. Colors were black, brown, green, red, blue and orange. Each word repeated six times by random, only once each batch. Specially, all subjects had been tested by SCL-90(Symptom Check List90), STAI-Trait questionnaire (1970), and Beck's Depression Inventory (1961).

The experiment of TU, Dresden (1999) used 3×4 multiple factor ANOVA analysis, assessing score of STAI produced a strong effect on groups, but no significant difference in RT. As what expected, nervous, anxiety and avoidance got significant difference among each other, for example, patients of GAD and SP showed much more nervous and anxiety, but no significant difference. When considering the avoidance factor, patient with GAD got a higher assessing score in anxiety than group of control. Surprisingly, words related to anxiety and words related to speech are not significant between GAD and SP (TU, resden.), which indicated that the anxiety level produced by GAD and SP were same to some extent. Though

this experiment studied anxiety by comparing with social phobia patients like before, it still could come out its relationship which was different from others.

Christianne M.Verhaak etc. (2004)explored the relationship between neuropath and typical anxiety disorder patients in non-clinical field by using intense stimulate. As same as what they supposed, they found the evidence to support the assessing anxiety relationship between neuropath and typical anxiety disorder patients. However, this experiment could not confirm the relationship among consciousness, unconsciousness interference and assessing anxiety, but merely to know a tendency existing between assessing anxiety and Stroop interference (Christianne, Jasper, Agnes & Floris, 2004).

2.3 Addictive Behavior

These years, with the social behavior standard improving at fast speed, addictive behaviors attract people's attention increasingly. So, it soon became the highlight in emotional Stroop effect researches.

2.3.1 Alcohol Dependence

The research, Johnson etc. (1994)found that the scores of interference in alcohol dependence patients were much higher than normal social drinker, with larger interference. One year later, Stetter etc(1995) proved that by experiment,and found that, comparing the neutral words, words related with alcohol need much more time to reflect, even though those data didn't reach the significant level. Moreover, some studies showed that normal drinkers also need longer RT towards alcohol words (Bauer Cox, 1998). Meanwhile, both Sharma etc. (2001)and Ryan (2002) indicated that attention bias played an part on correlative stimulate between alcohol abuser and non-abuser.

To test whether alcohol abuser would appear attention bias or not, Joanne Lusher etc.(2004)used Stroop to display similar stimulate of alcohol, and compare with the control group of non-alcohol abusers (Joanne, Chris & David, 2004). Subjects of experimental group (group of alcohol abusers) were tested by clinical therapy, being controlled by SADQ (Severity of alcohol dependence questionnaire, 1979). Experiment was divided into 4 parts, 32 items, 8 related to alcohol, 8 neutral. The alcohol words were picked up from main stream researches on alcohol dependence, while the neutral words were selected from family life according to the length and syllable. Both the error rate and duration time would be marked down.

Results from experiment by Joanne Lusher etc. (2004) indicated that ,the error rate in group alcohol abusers was lower than group of control, but not significant. Otherwise, subjects did not delay reflection to guarantee the accuracy, so majority of them turned out the ceiling effects (Joanne, Chris & David, 2004),that is, 96.9% reflection were accurate. The multiple measure ANOVA analysis of part of speech showed that, the reflection time which related to alcohol was significant longer, and group of control had significant shorter RT than group of alcohol abusers, with a significant interaction. The high dependence group and low dependence group were separated on the based of score of SADQ, but no significant difference found after multiple measure ANOVA analysis (Joanne, Chris & David, 2004). The Advantage in this experiment is controlling the objective factors of subjects and individual difference, and distinguishing two groups well.

Nevertheless, whether various severity of alcohol abuse could be the influencing factor? W.Miles Cox etc. (1998) (Cox, Giles & Cara, 1999) could proved it. The definition of serious alcohol abuser is drinking 25 units alcohol each week for male and 16 units per week for female; while the mild abusers drink less than 6 units alcohol each week. Their experiment adopted the edited version QQADI (Qualitative and Quantitative Alcohol and Drug Use Inventory, 1993) to assess subjects. Alcohol words, words related to music, and neutral words were displayed in experiment. Its result showed that, the serious abusers drunk 57.4 units alcohol per week average, and significant difference occurred both between type of words and two groups (Cox, Giles & Cara, 1999).

2.3.2 Heroin

Substance abuses included alcohol and some neural active medicine, or drug. Heroin is one of them. IngmarH. A. Franken etc.(2004) (IngmarH, Vincent, Cornelis, Wim, 2004)did a research on heroin dependence. Subjects came from a abstain center, all males. It was displayed 10 words related to heroin, and 10 neutral words with similar letter and syllable, four times for each word by random. In addition, they used the DDQ(Drug questionnaire,2002),DAQ(alcohol questionnaire,1998),ASI (1989),POMS(profile of mood states,1992)to assess subjects. Statistic results showed, there was no significant difference between type of words, but conditions of experiment (haloperidol,placebo)occurred significance. The RT acted obviously faster under the condition of haloperidol, in other words, the Stroop interference effect would be reduced after ingesting dopamine (IngmarH, Vincent, Cornelis, Wim, 2004).

2.3.3 Gambling

McCusker etc.(1997)studied the cognitive bias through emotional Stroop paradigm (Zhang, 2004).The classical result model was seen in Figure 2. Compared with seldom gambling people (group of control) and spouses, the color-naming time of gambling words among gambling abusers was significant longer than neutral words or other addictive words (such as, alcohol, smoking, medicine etc.). Abusers' spouses should be familiar with words of addictive behavior, but they did not appear Stroop interference effect. Result of this experiment showed, different addictive behavior type abusers had unconscious automatic bias while processing information related to that addictive behavior, which were independent from familiarity (Zhang, 2004).

2.4 Compulsive Disorder

When it comes to psychotic emotional Stroop effect, compulsive disorder was a piece of new land to explore by researchers. And some of them started to get down to it. Sreffen Moritz etc.(2003)(Steffen, Dirk, Martin, Susanne & Michael, 2004)held a research on patients with compulsive disorder, who would be selected by the symptom described in DSM-?. It displayed nine different conditions, 15 stimulates for each condition, while the conditions of emotion and personality were, anxiety, lose, responsibility, positive active and conscience. Statistic results showed, both the group effect and the condition effect reached the significant level, and RT in words related to lose feeling were significant slower than other types of words. However, the shortage of this experiment was that it still couldn't find out the significant difference between emotion and personality (Steffen, Dirk, Martin, Susanne & Michael, 2004).

3. Clinical Evidence of Emotional Stroop Effect

3.1 Electroencephalograph

Recent decades of years, there is a tendency which emotion studies and brain science became to cooperate together. Majority of these researches adopted the modern technology of electroencephalograph and biological measure technology. All those non-invasive technologies offer a good stage to study the brain mechanism of emotion. For example, Molt used fMRI and PET to maintain the asymmetry brain activities of up-limens emotion and below limens emotion, which had pushed the biological foundation studies of emotion to move ahead. It's believed that the N300 wave of ERPs had valuable influence on testing the emotion state or changes of brain. Besides, researchers explored the cognitive activities under the condition of depression by electroencephalograph, and its result showed that depression was much more related to activities of right brain, which proved by EEG, PET, and the observation of blood stream in brain. Otherwise, Mario, L. & Helen Su used to regard the pressure as index, did a study by PET, then found that prefrontal area , especially the prefrontal of right brain, being the essential area of negative relationship among emotion-cognitive thought-emotion(Chen & Liang, 2004)(Lootti, Mario & Helen, 2001)Definitely it would play a part on further studies between emotion and cognitive process.

3.2 Shield Technology

Recently, it's widely used a method called Shield Technology Paradigm. Shield technology, that is, to test the reflection of subjects on the original stimulate shield by a neutral stimulate after displaying an emotion stimulate. Liu Ronghui & Wang Lei found the unconscious startup effect of emotion, during the study on emotional startup effect under limens in 2000. (Chen & Liang, 2004)(Liu & Wang, 2002).

4. Theory Explanation of Emotional Stroop Effect

Although the task towards Stroop effect seems to be fairly simple, the mechanism behind would be complicated. Different explanations vary depending on researchers. And different explanations design their value in different fields of studies. Up to now, many theory model have been set up by researchers, while automatic theory taking the classical and leading place.

In automatic theory, the information processing system of human being was divided into two ways, automatic processing and control processing. Automatic way processes at fast speed, with no attention entered, and could occur anytime. On the other hand, control processing need to consume the attention resource, merely happening under conscious, with lower speed.

In task of emotional Sroop paradigm, the activation of emotional words semantic belongs to automatic processing, while color-naming being part of control processing. Under the condition of color word interference, familiar words or sensitive words to subjects would be in activation firstly. As a result, when color-naming, information of automatic activation would conflict with the information required to name its color. That is, subjects have to distinguish those two parts in order to act accurately. On the contrary , under the condition of control, if the experimental stimulates are non-emotional words, the meaning of automatic activation would be independent of the color of naming targets; if the experimental stimulates are series of characters, it wouldn't related to activation of semantic, without any conflict. Therefore, in the situation of color interference, the RT would be longer than condition of control, which called the emotional Stroop effect. Nevertheless, it was found that the activation of semantic not likely to be automatic process completely, so it was revised to be a continuous process which developed through learning and experience step by step. In the task of Stroop, the Stroop effect would be produced by interference of process of color-naming, which less automatic than reading words.

5. Prospect of Emotional Stroop Effect

5.1 Compare with Traditional Paradigm

Merel Kindt etc.(1996) (Merel, Dick & Jos, 1996)compared traditional Stroop paradigm and Emotional Stroop paradigm, and found that neither hadn't any convergent validity, which could lead them into unstable situation. As a result, he augured the stroop task, especially the emotional stroop task, could only be suitable to study the among-group difference between anxiety and non-anxiety, but not fix for assessing the interference of stable characteristic (Merel, Dick & Jos, 1996).

5.2 Prospect

Up to now, majority of researches still concentrate on field of psychopathy, while researches about emotional Stroop effect are not as many as foreign countries. In my eyes, besides studying anxiety or phobia of psychopathic illness, some kind of

emotion also could be taken into consideration, such as, exam anxiety, competition phobia and so on. Perhaps we could put them into practice in usual lives and make good use of it.

In addition, it's believed that the number of studies about emotion would be increasingly soared in China, considering its endless pressure in fast developing society. Not only be the emotion of adult should pay attention on, but part of children shouldn't be ignored.

With the development of modern cognitive neural technology, it could remedy the unstable shortage of emotional Stroop effect, completing much more accurate experiment by equipments.

In the same time, combining with field of biology and physic could be a tendency in future researches, which could describe its mechanism or process by understanding it structure and function in brain.

In short emotional Stroop effect still has got tremendous space and power to explore, no matter in or out, which would be continued in future.

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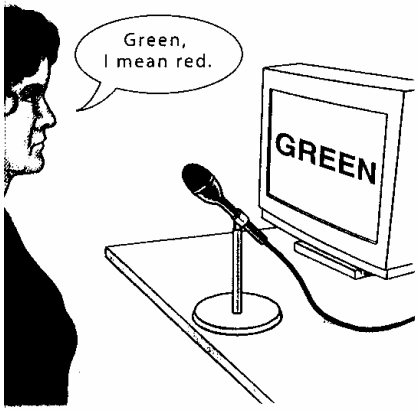

Figure 1. Traditional Stroop Operation

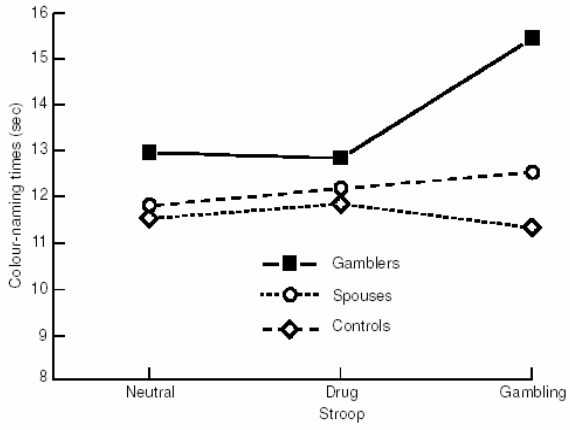

Figure 2. Color-naming RT in three groups(McCusker etc.,1997)