The Implicit Memory Bias During Pandemic Covid-19 in University Students

Liftiah Liftiah, Sukma Adi Galuh Amawidyati, Abdul Haris Fitri Anto
Sugiarianti Sugiarianti and Yurid Zaida Zen
Department of Psychology, Faculty of Education
Universitas Negeri Semarang, Indonesia
lifti4@mail.unnes.ac.id, sukmaadi@mail.unnes.ac.id, abdul.haris.fitri.anto@uinsby.ac.id,
sugiariyanti_psi@mail.unnes.ac.id, Zen.zaida45@gmail.com

Abstract
The Covid-19 pandemic has been causing mental health problems, one of which is anxiety. The cognitive model theory state bias in implicit memory plays a significant role in causing a person to experience intense anxiety and severity. This study aimed to examine the effect of stimulus presentation (threatening & non-threatening) on implicit memory bias in the anxious and non-anxious participants. This study used a factorial experimental research design and used the Psycopy version 3 program to create computer-based experimental manipulations. A total of 46 participants (22 anxious and 24 non-anxious) of college students joined this research. A computer-based Word Stem Completion Test (WSCT) used for measuring implicit memory bias and STAI for participants selection. A two-way ANOVA (2x2) with JASP software to test the hypothesis. The results showed that there was an effect of the presentation of the stimulus on implicit memory bias. The presentation of a threatening stimulus caused implicit memory bias in both groups (anxious and non-anxious).The implication study results will be discussed in more detail in the discussion.

Keywords: implicit memory bias, anxiety, Word Stem Completion Test (WSCT), pandemic Covid-19

1. Introduction
The influenza pandemic is one of the world's major health threats today (Taylor, 2019). The emergence of various kinds of viral and bacterial mutations has sparked fears of a global outbreak of other infectious diseases (Nerlich & Halliday, 2007; Taylor, 2019). Since the end of 2019, the world has been tense due to the coronavirus outbreak's emergence. This virus was first discovered in the Wuhan area of China and has become a world pandemic.

Pandemics are often associated with the emergence of psychosocial stressors, including health threats to oneself and loved ones, changes in activities and routines, death of loved ones, lack of food and medicine, loss of income, social isolation due to quarantine, and social distancing programs, closure of schools to areas, locked down (Khan Sameer & Damir, 2019; Shultz:Espinel;Flynn;Hoffman;Cohen, 2008; Taylor, 2019).

The coronavirus pandemic has indeed given rise to residents' anxiety. If left untreated, anxiety can lead to mental and psychological disorders. One of the psychologists from Sebelas Maret University, Nugraha Arif Karyanta, stated that from March 25 to March 30, 2020, he had handled 16 people with various psychological problems. Most of these are related to pandemic anxiety disorders. One of the cases he handled was a man who experienced excessive worry because when he went to the mosque, a congregation was coughing. In that case, the fear of coughing raises physical pain complaints due to anxiety, such as a pounding chest (Firmansyarh, 2020).

Suicide cases due to the Covid-19 pandemic have also occurred in several countries, including Indonesia. A nurse in Italy committed suicide due to experiencing severe stress after being tested positive for Covid-19 (Merdeka.com, 2020). In Indonesia, an online taxi driver in the Bekasi area hanged himself in his backyard due to not paying car installments because he had not worked for two months due to the pandemic (Gunawan, 2020).

The emergence of psychosocial problems during the pandemic has increased anxiety and psychological pressure on society. Anxiety at an average level is something healthy and adaptive. It is usual for individuals to be a little worried about the aspects that occur in their life. Anxiety is useful if it encourages individuals to do coping what

they can do. Some people may have the ability to tolerate a certain level of discomfort and healthily manage their anxiety. However, anxiety can become abnormal if the levels do not match the threat proportion because it is quality disturbing.

Anxiety disorder is unfounded fear and unrealistic anxiety (Carlson, 2013). Anxiety disorders are the most common psychiatric disorders, with around 28 percent (Carlson, 2013; Kanto et al., 2020; Umanailo et al., 2021)). Anxiety disorders contribute to the emergence of more severe psychopathological disorders such as depression, substance use, phobias (Amir et al., 2010; Coles & Heimberg, 2002; Teachman, 2005). The results show a relationship between the cognitive system and anxiety (Amir et al., 2010). The theory of anxiety from the cognitive approach states that anxious anxious and non-anxious people will process information differently (Memarian & Azaraein, 2015; Mueller et al., 1993).

The cognitive model theory of anxiety suggests that biased patterns in information processing play a role as the leading cause of a person experiencing intense anxiety symptom susceptibility and a manifestation of the severity of the anxiety disorder experienced (MacLeod & McLaughlin, 1995; MacLeod & Mathews, 2012). Several research results support the existence of a memory bias associated with anxiety disorders (Coles et al., 2007; Coles & Heimberg, 2002; Memarian & Azaraein, 2015).

The results of a meta-analysis of research conducted by Coles and Heimberg (2002) show that subjects who experience anxiety disorders will show a memory bias during information processing. Subjects with Posttraumatic Stress Disorder (PTSD) and Obsessive-Compulsive Disorder show bias in explicit memory. Meanwhile, in anxiety disorders (Generalized Anxiety Disorder) and social phobia, the implicit memory is biased.

The results of research conducted by Memarian and Azaraein (2015) on students showed that there were differences in memory bias between subjects who experienced anxiety and subjects who did not experience anxiety. Subjects who experienced anxiety showed an implicit memory bias towards the negative information presented. In contrast, subjects who did not experience anxiety did not show implicit memory bias on the negative information presented. This study also showed no difference in explicit memory bias in the experimental group and the control group. This study concludes that subjects who experience anxiety tend to experience implicit memory bias when facing negative information.

However, not all research results support the existence of memory bias in subjects experiencing anxiety (Baños et al., 2001; Wenzel & Holt, 2002). The research results showed that subjects who experienced emotional disturbances did not experience bias in implicit or explicit memory. Wenzel & Holt (2002) also show that subjects who experience social phobia also do not exhibit implicit and explicit memory bias.

The theory of emotional disorders states that emotional disorders such as anxiety occur due to memory bias from preferences to process information relevant to threats. The cognitive model theory also states that anxious people's particular characteristic is to experience bias in recalling information. This bias maintains a significant role in the development of anxiety disorders for a long time. Previous research showed that implicit memory bias had happened in anxiety disorder cases such as social phobia, depression, and PTSD. However, previous research still shows contradictory results, so further research is still needed to explore the process of implicit memory bias in cases of anxiety.

1.1 Objectives

The objectives of this study are as follows:

1. To examine the effect of stimulus presentation (threatening and non-threatening) on implicit memory bias
2. To examine the effect of anxiety level on implicit memory bias
3. To examine the interaction between anxiety and stimulus type against implicit memory bias

2. Literature Review

Wolman and Stricker (1994) define anxiety disorder as a stressful condition and prediction of disaster. Moreover, anxiety is a vague feeling of anxiety, which is a form of anticipation of death or disaster thoughts (Edward P. Sarafino, 2008). Wolman and Sticker (1994) describe that anxiety will hinder an individual's ability to act. Individuals with anxiety disorders will withdraw from society. They will gradually affect a person's intellectual

functioning, especially in memory function and the individual's ability to express something. Anxiety disorders can also cause psychosomatic symptoms (B. B. Wolman, 1994).

Memory bias is a cognitive bias that can improve or impair memory (either the possibility of whether the memory will be recalled or the amount of time it takes to recall the memory or both) or cognitive bias that can change reported memory content. Tryon (2014) defines memory bias as the tendency to recall memories in tune with current emotional states.

Beck's theory states anxiety is a product of biased information processing from a stimulus (either from within or outside a person) perceived as a threat (Beck, 2005). This cognitive bias produces a cognitive distortion, a systematic distortion in a person's thinking process and in the process of constructing a person's experience (Yurica & DiTomasso, 2006). This biased information processing will affect the emotions, behavior, and physiological responses of individuals who experience anxiety (Wilkerson et al., 2005). Knowing how memory bias works, a therapist or psychologist can help an anxious subject better deal with this bias. Understanding memory bias is essential for developing coping strategies (Tryon, 2014).

Cognitive psychology emphasizes the concept of threats and the role of threats in processing information obtained from the environment (Wilkerson et al., 2005). According to the cognitive theory expressed by Beck (1976), a cognitive perception that views the environment as a threat is a characteristic of the emergence of anxiety that causes emotional disturbances in a person.

Beck states that anxiety is biased information processing from a stimulus (either from inside or outside a person) perceived as a threat (Beck, 2005). This cognitive bias produces a systematic distortion in a person's thinking process and in the process of constructing a person's experience, which is often referred to as cognitive distortion (Yurica & DiTomasso, 2006). The main thing that underlies this cognitive error is the persistent dysfunction of beliefs in the cognitive structure in the form of a schema. Specifically, the cognitive model of anxiety establishes a danger-oriented belief attached to the cognitive schema. This schema causes individuals to narrow their attention to a threat only, have irrational thinking, engage in a behavioral dysfunction, or over-interpret (catastrophic) an ambiguous stimulus (Beck, 2005). In the case of anxiety disorders, this cognitive bias is found in all aspects of the information processing process, including individual perceptions of a stimulus, interpreting that stimulus, and even the process of recalling memories related to a stimulus or information (Beck, 2005).

A person with high anxiety has an active threat scheme and makes them more likely to perceive incoming information as dangerous (Vikan et al., 2010; Wilkerson et al., 2005). According to Beck, when a hazard or threat scheme is activated, an anxious person will prioritize incoming information congruent with the threat scheme. Consistent with Beck, Williams et al (1988) suggest that anxious individuals have a bias towards processing threatening information; even so, they automatically pull toward threatening information without full attention (Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathew, 1988).Various experimental methods have been trying to investigate this proposition, including dichotomous listening tasks (Mathews, A., & MacLeod, 1986), emotional or modified Stroop color-naming tasks (Mathews, A., & MacLeod, 1985; Mathews, A., Mogg, K., May, J, & Eysenck, 1989), and related tasks with reaction time (MacLeod, C., & Mathews, 1991).

Williams et al. (1988) also predict that there are differences in memory processing functions. Mathews et al. (1989) tested the explicit memory bias and implicit memory bias using three groups of participants. The group consists of subjects who experienced anxiety, subjects who recovered from anxiety, and normal subjects as a control group. The measurement of explicit memory in the three groups of participants showed that the measurement of explicit memory (using a stem cued recall task) did not produce a memory bias for threatening words (items) compared to neutral items. However, in the implicit memory measurement by using word stem completion, the group of subjects diagnosed with anxiety disorders showed a tendency to experience implicit memory bias for threatening words. Besides, the control group showed a memory bias for non-threatening information. These results conclude that there is a tendency for individuals who experience anxiety to implicitly recall threatening information. In contrast, individuals who are not anxious and who recover from anxiety implicit tend to recall non-threatening information.
The hypotheses proposed in this study are: 1.) There is an effect of stimulus presentation (threatening and non-threatening) on implicit memory bias; 2.) There is an effect of anxiety level on implicit memory bias; 3.) There is no interaction effect between anxiety and the type of stimulus on implicit memory bias

3. Methods

This study used a factorial experimental design. The design that involves more than one independent variable, where each independent variable has two or more variations (Seniati et al., 2015). We used Randomized Factorial Design (2x2). (i.e., anxious and non-anxious) and (i.e threatening and neutral stimuli), An overview of the experimental research design showed in the table 1.

Table 1. Research Design

	Information stimuli	
	Threatening stimuli	Neutral stimuli
Anxious	Anxious & threatening stimuli	Anxious & neutral stimuli
Non anxious	Non anxious & threatening stimuli	Non anxious & neutral stimuli

3.1. Participants

This study involves 46 college students in Semarang. Participants receive a reward (i.e an amount of e-money) for their participation. The characteristics of the participants in this study are as follows:

1. Subjects who experience high anxiety tendencies, namely subjects who obtain anxiety scores in the high category (score above 110) on the STAI (State-Trait Anxiety Inventory) scale.
2. Subjects who have a low anxiety tendency, namely subjects who obtain anxiety scores in the low category (score below 66) on the STAI (State-Trait Anxiety Inventory) scale.
3. Participants did not experience clinical psychological disorders while attending the research process.

3.2. Instruments

We use computer-based instruments in this research. We create computer-based instruments on the Psychopy v3.0. Psychopy is a free platform package that allows researchers to create and run experiments in psychology, neuroscience, and psychophysics. The instruments used in this study were as follows:

1. State-Trait Anxiety Inventory (STAI)-Trait
   The STAI measuring instrument was first developed by Charles D. Spielberger, Richard L. Gosrsuch, and Robert E. Lushene in 1964. The STAI has been adapted in more than 48 languages for cross-cultural research and clinical practice (S. R. Tilton, 2008). Many kinds of research has proved that STAI suitable and adequate for measuring anxiety, especially in clinical settings (S. R. Tilton, 2008). High scores on STAI indicate high anxiety, while low scores on STAI indicate low levels of anxiety. The STAI scale has two subscales, namely STAI State and STAI Trait. STAI-State aims to measure anxiety that is temporary and occurs at a certain time. In contrast, STAI-Trait aims to measure the level of anxiety associated with personality traits that make a person prone to experiencing general anxiety. In this research, we use seven choice answers in STAI-Trait (almost never-almost always). The internal consistency of STAI resulted in a Cronbach alpha reliability coefficient of 0.884 for the STAI trait scale. The STAI-Trait Scale presentation in this study uses a computer-based survey administration software, a google form.

2. Word Stem Completion
   It is one of the assignment methods (behavioral task) to measure implicit memory (Amir et al., 2010; Memarian & Azaraein, 2015; Wilkerson et al., 2005). Word Stem Completion is a procedure in which participants must complete letters from the vocabulary that have been presented or have not been presented correctly in a fast time. The vocabulary used in this task is threatening vocabulary (e.g., sick, death) and neutral vocabulary (e.g., chairs, tables). For example, *SAK_ _* (SICK). The more extended the average amount of time it takes to provide an answer, indicating a low implicit memory capability. The Word Stem Completion Test is a computer-based computer program. A total number of threatening words that appear indicates an implicit memory bias.
   WSCT consists of 36 threatening vocabularies and 36 neutral ones. The threatening vocabulary used in this study refers to the results of previous study (Vasey et al., 1995). In addition to using threatening vocabulary from Vasey's (1995) research, the research team also conducted a preliminary study regarding threatening words during the Covid-19 pandemic. The entire threatening vocabulary used in this study has reviewed from the expert panel to meet logical validity requirement. The qualifications of the panel of experts involved in this research is at least a master's graduate in psychology or a psychologist. This study involved two psychologists and two Masters in Psychology as a panel of experts in assessing threatening vocabulary.

3.3. Procedure

The first stage in the research is to obtain research participants. Researchers open the call to be research participants through social media. Candidate participants who are willing to become research respondents register via the online google form and fill out the online informed-consent. Furthermore, candidate participants who have registered begin to fill in the STAI-Trait scale distributed via the google form. The researcher then selects candidate research participants based on the research requirements. One hundred students are willing to become research participant candidates. However, only 46 students meet the criterias (22 experiencing high anxiety and 24 have low anxiety level). The next is the experimental stage. The participants performed a behavioral task, namely the Word Stem Completion Test game for measuring implicit memory bias, in approximately 15 minutes. Participants are asked to fill in incomplete words that appear on the computer screen.

4. Results and Discussion

The results showed that the number of participants in each group was explained as follows: 1.) Group 1 (Anxious-neutral) had 11 participants, consisting of 8 women and three men; 2.) Group 2 (anxious threatening) totaling 11 participants, consisting of 8 women and three men; 3.) Group 3 (non-anxious-neutral) had 12 participants, consisting of 8 women and four men; 4.) Group 4 (non-anxious-threatening) consists of 12 participants, consisting of 8 women and four men. We use a two-way analysis of variance (2x2) in JASP version 13.00 data processing software to test the hypotheses. The result of descriptive statistic analysis is presented in the table 2 below.

Table 2. Descriptive Statistic

Descriptives - N of threat words				
group	stimuli	Mean	SD	N
Anxious	Neutral	1.09	0.83	11
	Threatening	21.18	5.69	11
Non Axious	Neutral	1.08	0.51	12
	Threatening	19.58	3.92	12

Based on table 2, the mean for the anxious group who received a threatening stimulus showed a higher score (M = 21.18) than the mean for the anxious group who received a neutral stimulus (M = 1.09). In the non-anxious group, the mean group that received a threatening stimulus also showed a higher score (M = 19.58) when compared to the non-anxious group who received a neutral stimulus (M = 1.08).

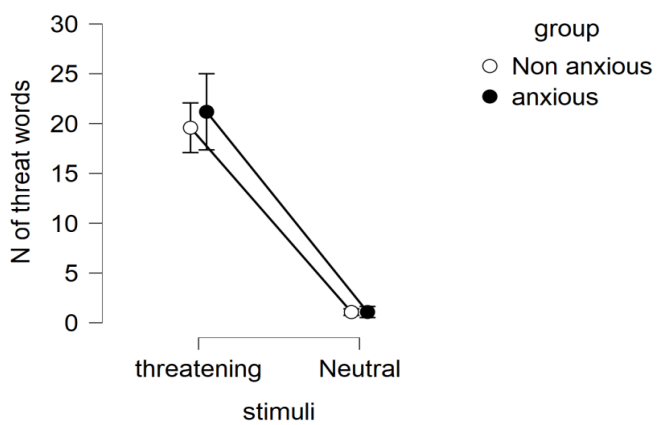

Figure 1. Mean Between Group

Figure 1 shows that both anxious and non-anxious groups experienced a high implicit memory bias towards threatening stimuli. In contrast, the two groups (anxious and not anxious) have low implicit memory bias in neutral stimuli. We performed a two-way Anova to test the hypothesis.

Table 3. Anova Table

ANOVA - N of threat words						
Cases	**Sum of Squares**	**df**	**Mean Square**	**F**	**p**	**η²**
group	7.40	1	7.40	0.62	0.44	1.55e -3
stimuli	4273.52	1	4273.52	357.28	< .001	0.89
group ✻ stimuli	7.26	1	7.26	0.61	0.44	1.52e -3
Residuals	502.38	42	11.96			
Note. Type III Sum of Squares						

Based on table 3, the result of the two-way anova analysis are: 1.) there is no difference in implicit memory bias between groups anxious and non-anxious (F = 0.62; p> 0.05); 2.) there is a difference in implicit memory bias between threatening and neutral stimulus (F = 357.28; p <0.05); 3.) there are no interactions between anxiety and the type of stimulus against implicit bias memory (F = 0.61; p> 0.05). The results of this analysis support hypotheses 1 and 3 but do not support hypothesis 2. We performed further analysis to see if there was a significant difference in each stimulus presentation's mean score using t-test analysis. Table 4 presents the results of the t-test analysis of Implicit Memory Bias toward Stimulus Presentation (threatening and neutral).

Table 4. Implicit memory bias toward different stimulus presentation (threatening and neutral)

Independent Samples T-Test				
	Test	**Statistic**	**df**	**p**
N of threat words	Student	-19.05	44	< .001
	Mann-Whitney	0.00		< .001

Based on table 4, there is a significant difference on implicit memory bias (t=-19,05; p<0,05). There is differences implicit memory bias upon stimulus presentation. The results of this analysis support hypothesis 1 in this study. We performed further analysis to see if there was a significant difference in each group's (anxious vs. non-anxious) mean score using t-test analysis. Table 5 presents the results of the t-test analysis of implicit memory bias between two groups (anxious-non-anxious).

Table 5. Implicit memory bias toward anxiety level (anxious vs. non-anxious)

Independent Samples T-Test			
	t	**df**	**p**
N of threat words	-0.26	44	0.80
Note. Student's t-test.			

Based on table 5, there is no significant difference in implicit memory bias (t=-0,26; p>0,05). There are no differences in implicit memory bias between the anxious and non-anxious group. The results of this analysis do not support hypothesis 2 in this study. Further analysis of the effect of threatening stimuli in the anxious and non-anxious groups was performed with the t-test. Table 6 and 7 present the results of the t-test analysis of threatening stimuli on both of group.

Table 6. Implicit memory bias toward threatening stimuli on anxious group

Independent Samples T-Test				
	Test	**Statistic**	**df**	**p**
N of threat words-anx	Student	-11.59	20	< .001
	Mann-Whitney	0.00		< .001

Table 7. Implicit memory bias toward threatening stimuli on non-anxious group

Independent Samples T-Test			
	t	**df**	**p**
N of threat words-nonAnx	-16.21	22	< .001 [a]
Note. Student's t-test.			
[a] Levene's test is significant (p < .05), suggesting a violation of the equal variance assumption			

Based on the t-test analysis in tables 6 and 7, the conclusions that can be drawn are:1.) there is an effect of a threatening stimulus on implicit memory bias in the anxious (t=-11,59; p<0,05) and non-anxious (t=-16,21;p<0,05) groups.

The analysis results show that there is an effect of the stimulus presentation on implicit memory bias. The result is in line with previous research (Memarian & Azaraein, 2015; Russo et al., 1999). Anxiety level does not affect implicit memory bias. It may occur because the participants involved in this study did not diagnose having clinical disorder. It is in line with previous research, which states that implicit memory bias occurs in groups who experience clinical disorders such as social phobia (Coles & Heimberg, 2002; Memarian & Azaraein, 2015; Wenzel & Holt, 2002), depression (Baños et al., 2001; Barry et al., 2004), PTSD (Amir et al., 2010; Coles & Heimberg, 2002) and does not occur in non-cilinical anxious samples (Wilkerson et al., 2005).

6. Conclusion

Generally, this study's conclusion suggests an effect of the presentation of the stimulus on implicit memory bias. Only the threatening stimulus presentation affects implicit memory bias, both in the anxious and non-anxious groups. Moreover, there is no difference in implicit memory bias in presenting neutral stimuli, both in the anxious and non-anxious groups.

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Biography

Liftiah is an Associate Professor in the Department of Psychology Universitas Negeri Semarang, Indonesia. She earned a Bachelor's degree in psychology from Universitas Gadjah Mada (UGM). She graduated Master's Degree in Clinical Psychology from Universitas Gadjah Mada (UGM). She is a clinical psychologist. Now she is taking a Doctoral program in cognitive psychology at National Chung Cheng University, Taiwan. Her research interest includes aggression, cognitive bias, mental health, and abnormal psychology.

Sukma Adi Galuh Amawidyati is an Assistant Professor in the Department of Psychology Universitas Negeri Semarang, Indonesia. She earned a Bachelor's degree in psychology from Universitas Gadjah Mada (UGM). She graduated Master's Degree in Educational Psychology from Universitas Gadjah Mada (UGM). She is a psychologist in the educational field. She is interested in cognitive psychology, psychometrics, and educational psychology. Her research interest includes cognitive and memory bias, grit, cyberpsychology, mental health, and measurement. She is a member of HIMPSI (Indonesia Psychology Association), APSI (Indonesia School Psychologist Association), and APSIMETRI (Indonesia Psychometrician Association).

Abdul Haris Fitri Anto is a lecturer in the Department of Islamic Family law in Universitas Islam Negeri Sunan Ampel Surabaya. He earned a Bachelor degree in psychology from Universitas Negeri Semarang then graduated his Master Degree in Social Psychology from UNIKA Soegijapranata Semarang afterward. He is interested in cognitive

psychology, social psychology, family psychology, and javanese psychology. His interest research relates to identity, intergroup relation, and religious moderation.

Sugiariyanti is an Assistant Professor in the Department of Psychology Universitas Negeri Semarang, Indonesia. She earned a Bachelor's degree in psychology from Universitas Muhammadiyah Surakarta. Sh e graduated Master's Degree in Developmental Psychology from Universitas Gadjah Mada (UGM). Her interest research is in developmental psychology, bullying, and special need children.

Yurid Zaida Zen is a student in the Department of Psychology Universitas Negeri Semarang, Indonesia. He earned a bachelor's degree in psychology from Universitas Negeri Semarang in 2020. He is a member of the grand research team about cognitive bias with Sukma Adi Galuh Amawidyati. His thesis is measuring brand image by using Implicit Association Test (IAT) in college students. Now he works as a human resource staff in a private company in Indonesia.