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FORCED-CHOICE PRIME VISIBILITY TEST: UNRAVELING THE TARGET SEQUENTIAL EFFECT

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Abstract
Unconscious processing of visual stimuli is a crucial area of study, and it is essential to ensure that the processing is indeed unconscious. This study explores the methods for ascertaining unconscious processing, including subjective reports and the combination of subjective and objective measures. Blindsight, a phenomenon in which individuals exhibit above-chance accuracy in identifying "undetected" stimuli, even though they claim not to see them, serves as a prominent example. While some researchers argue that blindsight represents severely degraded processing, many others contend that it is evidence of unconscious visual processing. This paper delves into the subjectivity of reports in indicating unconsciousness to visual stimuli and explores the implications of blindsight for the understanding of unconscious processing.

1 Introduction

In studies of unconscious processing, it is very important to ensure that the processing of the masked stimulus was unconscious or subliminal. The methods of ensuring processing unconsciousness include subjective reports as in blindsight studies and the combination of subjective and objective methods. Blindsight refers to unconscious vision in response to stimuli presented to the blind hemifield of patients with damage to the primary visual cortex in which the patients reveal above-chance accuracy in the identification of the "undetected" stimulus in a forced-choice test even though they claim not seeing the stimulus. Although some researchers suggest that blindsight is merely a severely degraded processing (Overgaard, Fehl, Mouridsen, Bergholt, & Cleeremans, 2008; Phillips, 2021), many believe that blindsight is evidence for unconscious visual processing (Overgaard, 2015). In the blindsight research, the above chance-level responses in a forced-choice test are thought to reflect the unconscious processing of the stimulus when the patients subjectively report no conscious experience (Pöppel, Held, & Frost, 1973). Thus, in this method, subjective reports were used to indicate participants' unconsciousness to the stimulus. In studies of unconscious information processing in healthy people, paradigms were devised to render the visual stimuli subliminal to the participants, by using, for example, masking method (van Gaal et al., 2014), crowded technique (Zhou, Lee, Li, Tien, & Yeh, 2016) and continuous flash suppression (Zhou, Lee, Li, Tien, & Yeh, 2016). Many results using these paradigms demonstrated the existence of unconscious processing of single

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stimulus (Atas, Vermeiren, & Cleeremans, 2013; Valdés, Catena, & Marí-Beffa, 2005) or unconscious integration between multiple stimuli (Faivre, Mudrik, Schwartz, & Koch, 2014; Opstal, Gevers, Osman, & Verguts, 2010; Tu et al., 2020). It is worth noting that in these studies the inference of unconscious processing was based on an important premise that the particular stimulus was indeed subliminal.

In contrast to verbal reports in the blindsight studies, more restrictive visibility tests were conducted in contemporary research in order to ensure that the processing of the stimulus was unconscious (Ansorge, Khalid, & Laback, 2016; Izatt, Dubois, Faivre, & Koch, 2014; Liu et al., 2016; van Gaal et al., 2014). Because there is evidence that verbal reports, i.e., a subjective measure, are not always reliable (Newell & Shanks, 2014; Wang et al., 2021), researchers now usually combine subjective measures with objective measures to assess stimulus visibility to the participants. Commonly used subjective measures are the perceptual awareness scale (Ramsøy & Overgaard, 2004), confidence ratings (Ramsøy & Overgaard, 2004) and post-decision wagering (Persaud, McLeod, & Cowey, 2007). The most widely used objective measure is the forced-choice test (van Gaal et al., 2014) based on the signal detection theory (Hancock & Wintz, 1966).

In the studies of using objective measures, some carry out the forced-choice task (the most widely used objective measure) at the end of priming-task experiment, separate from the unconscious priming experiment (Ansorge, Khalid, & Laback, 2016; van Gaal et al., 2014), whereas others complete the forced-choice task immediately after the response to the target within each trial (Izatt, Dubois, Faivre, & Koch, 2014; Liu et al., 2016). The latter researchers argue that if a participant does not take a visibility test immediately after responding to a target stimulus, unknown factors, such as changes in sensory thresholds over time can be introduced and affect the results of the visibility test. Even if that is the case, the latter method might have one drawback not mentioned by its advocates, i.e., the supraliminal target might influence the response in the forced-choice visibility task. This effect is analogous to a response sequential effect in absolute judgments in which a given response (Nth response) can influence the response that follows it (N+1 response) (Laming, 1997; Steward et al., 2005). In absolute judgments, the second response (response N+1) can be either assimilated to the first response (response N) by bringing it closer to it, or contrasted with it by making it more different from the first stimulus (Steward et al., 2005). The tendency of avoiding repeating the same response in succession is also analogous to a phenomenon known as inhibition of return in perception (Klein, 2000; Taylor & Klein, 1998) in which observers show a tendency to not repeatedly orient their visual attention to the same spot where they have just detected a target in the form of producing longer response times or lower performance accuracy if the target still appears at the same spot. Both types of sequential effects make the response less accurate (Steward et al., 2005). Specifically in the unconscious priming studies, the response in the visibility test might be closer to or contrasted with the previous response to the target.

Therefore, to avoid this potential confound in unconscious priming studies, should the forced-choice visibility test be conducted after the priming-task experiment rather than right after the participant's responding to the target in each trial? This question is the focus of the present study. First, we conducted masking experiments with different types of stimuli in which the influences of the prime and the target on the forced-choice discrimination were both assessed when the prime-visibility test was conducted within each trial. If the target is found to affect the forced-choice prime discrimination result, conducting the visibility assessment within each trial can sometimes be problematic. Moreover, we compared the prime visibility test that was conducted within each trial with one that tested visibility separately at the end of the priming-task experiment.

2 Experiment 1

2.1 Methods

2.1.1 Participants

The sample size of the experiment was estimated in advance by the G*Power software (Faul et al., 2007). To achieve a medium effect size of f = 0.25 and statistical power of 0.8, 24 participants were required. We recruited twenty-five healthy, right-handed volunteers (mean age=21.2 years, SD =2.2 years) with normal or corrected-tonormal vision. There was no participants' reported history of, or current neurological or psychiatric conditions. The research was approved by the local ethics committee. The participants gave their informed consent before the experiment. None of the participants was aware of the purpose of the experiment. After the experiment, everyone was paid for his or her participation.

2.1.2 Stimuli and apparatus

The stimuli consisted of 26 tool and 26 fruit Chinese words, with each word being a double-character word. The stimuli were presented to the participants using E-prime 2.0, on an ASUS 22-inch display monitor (60 Hz refresh rate). The size of each word was approximately .8° (horizontal) × .8° (vertical).

2.1.3 Procedure

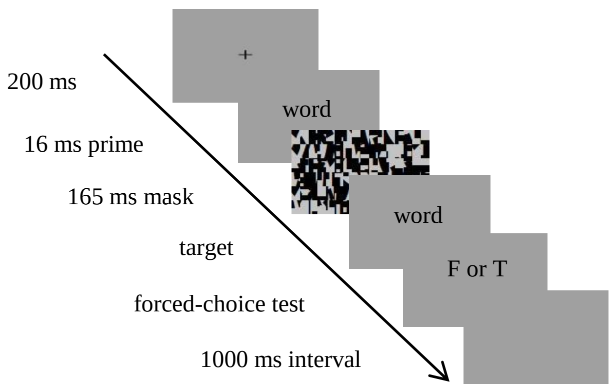

Figure 1. Schematic illustration of the sequentially displayed stimuli. The two words in each trial are different. F represents fruit words and T represents tool words.

The procedure is illustrated in **Figure 1**. Each trial began with a central fixation for 200 ms. Then, a word (tool or fruit word) appeared for 16 ms at the center of the screen. Subsequently, a backward mask was presented for a duration of 165 *ms*. Finally, an ending word (a tool or fruit target word) was displayed in the center of the screen until a response was made or 3000 *ms* expired. In the experiment, the response- button assignment was counterbalanced, that is, half of the participants pressed "1" if they saw the target word was a fruit word and "2" if it was a tool word, whereas the response key assignment was reversed for the other half participants.

Immediately after participants responded to the target word, they took the forced-choice prime-visibility test. In the forced-choice visibility test, the participants had to make a choice about whether the masked word was a tool or a fruit word. The participants were asked to make a choice even if they claimed that they did not see the masked word. In the forced-choice task, there was no time limit for the response so that the participants could respond as accurately as possible. After they finished the forced-choice visibility task, the next trial began after a 1000 *ms* inter-trial interval. There were 52 forced-choice trials for each prime word category. After the experiment, participants were also asked to report whether they saw anything other than the target word in the priming experiment.

2.1.4 Design

There were four experimental conditions based on the forms of the matching arrangements between the prime and the target: TT, TF, FF, and FT (F indicates a fruit word and T a tool word). In each notation, the left capital letter denotes the word category of the prime, and the right capital letter the category of the target. The primary purpose of this experiment was to explore whether the prime and target stimuli could affect the subsequent responses in the forced-choice task of the prime visibility test. So, besides analyzing the unconscious priming effect, it is equally important to analyze the effects of the prime and the target on the forced-choice visibility test performance. Again, there were 52 trials under each condition.

2.2 Results

2.2.1 Prime visibility

Participants reported that they could not detect the masked two-character words. In the forced-choice task, all 25 participants performed at the chance level when considering the overall average of each participant. The mean percentage of correct recognition was 50.4%, not significantly different from the chance level, $t(24) = 1.171$, SE=1.7%, $p = .253$, nor was the *d*' value significantly different from zero, $t(24) = 1.388$, $p = .178$.

The accuracy data of the forced-choice visibility test were submitted to a 2 (prime type: tool vs. fruit) × 2 (target type: tool vs. fruit) repeated-measures ANOVA. The results showed no main effects of prime type, $F(1,24) = 1.174$, $p = .289$, $\eta_p^2 = .047$, nor of target type, $F(1,24) = 1.820$, $p = .190$, $\eta_p^2 = .071$. However, the prime type by target type interaction was significant, $F(1,24) = 26.484$, $p < .001$, $\eta_p^2 = .525$. Simple analyses demonstrated that, when the prime was a fruit word, the accuracy of the fruit target (.44) was significantly lower than that of the tool target (.63), $F(1,24) = 24.42$, $p < .001$. When the prime was a tool word, the accuracy of the tool target (.39) was significantly lower than that of the fruit condition (.55), $F(1,24) = 24.51$, $p < .001$. When the target was a fruit word, the accuracy of the fruit prime condition (.44) was lower than that of the tool prime condition (.55), although the difference was not significant, $F(1,24) = 2.42$, $p = .133$. Finally, when the target was a tool word, the accuracy of the tool prime (.39) was significantly lower than that of the fruit prime (.63), $F(1,24) = 14.01$, $p = .001$. These results are presented in **Figure 2**.

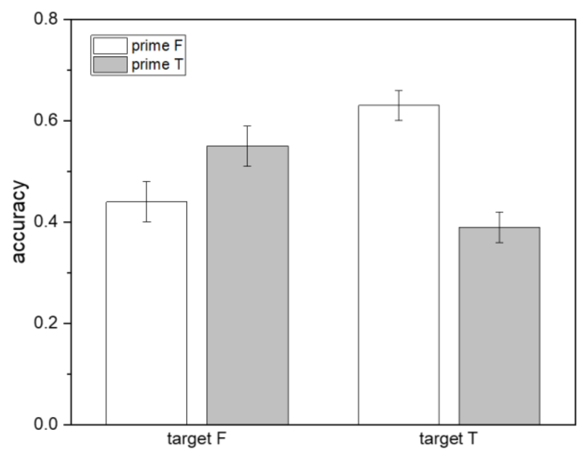

Figure 2. Mean rate of accuracy of the forced-choice task under each condition in Experiment 1. Error bars represent standard errors of means. F represents "fruit" and T represents "tool".

Overall, the results showed that participants tended to make a response in the forced-choice test for visibility contrary to the target category or, in other words, to avoid making the same response in the visibility test that they made to the target (more explanation was given in the discussion).

Two additional analyses were conducted to provide further support for the argument that the visibility test results were influenced by the target category, but not by the prime. In the first analysis, the data of the forcedchoice visibility test were transformed to the rates of the responses contrary to the target (see **Table 1**). The repeated-measures ANOVA showed that the main effects of the prime, target, and the interaction between the two factors were all non-significant, *Fs* < 1.820, *ps* > .190. The non-significant effect of the prime revealed that the response tendency contrary to the target in the forced-choice task was not affected by the prime.

Table 1. The numbers are the mean rates of the responses contrary to the target in the forced-choice prime visibility test. The letters in the parentheses are the actual response made in the force-choice test.

Prime

Fruit Tool

Fruit .56 (T) .55 (T)
Target Tool .63 (F) .61 (F)

In the second additional analysis, the data of the forced-choice visibility test were transformed to the rates of the actual "F" response (see **Table 2**). The repeated-measures ANOVA showed that the main effect of target type was significant, $F(1,24) = 26.484$, $p < .001$, $\eta_p^2 = .525$. The main effect of prime type was not significant, $F(1,24) = 1.377$, $p = .252$, $\eta_p^2 = .054$, nor was the prime by target interaction significant, $F(1,24) = 1.820$, $p = .190$, $\eta_p^2 = .071$. The non-significant effect of prime revealed that the F response in the forced-choice test was not affected by the prime type. As shown in **table 2**, the significant effect of the target reflected a tendency of making a response

2.2.2 No unconscious Priming effect

The accuracies and RTs for the target response were submitted to a repeated measures ANOVA same as the one for the visibility accuracy data. The results showed that the main effects of the prime, target, and the interaction between the two factors were all non-significant, $Fs < 2.240$, $ps > .134$ both in accuracy and in RT.

To reiterate, Experiment 1 showed that there was no priming effect. Instead, the forced-choice response in the prime visibility test was affected by the target such that participants tended to avoid repeating the same response they made to the target.

3 Experiment 2

The results of Experiment 1 showed that in the forced-choice prime visibility test, participants tended to respond with a choice contrary to the target category. But strangely, no unconscious priming effect was observed. We hypothesize that the visibility test might have interfered with the priming process. Experiment 2 repeated Experiment 1 except that the forced-choice visibility test was conducted separately after the whole priming experiment was completed. If a priming effect is observed in Experiment 2, we can infer that in Experiment 1, the within-trial forced-choice visibility test suppressed the priming effect by veering the response away from the target response the participants made immediately before they responded to the forced-choice question. In Experiment 2, because the forced-choice visibility test was conducted separately from the priming experiment, there was no way to analyze the influence of the primes and targets from the priming experiment on the forced-choice prime discrimination.

3.1 Methods

3.1.1 Participants

The sample size estimated from the G*Power software to achieve an effect size of f = .25, a power of .80, and a p-value of .05 was 24. Twenty-five healthy, right-handed volunteers (mean age=20.6 years, SD =1.8 years) with normal or corrected-to-normal vision participated in the experiment. There was no participants' reported history of (or current) neurological or psychiatric conditions. They gave their informed consent before the experiment. The research was approved by the local ethics committee. None of the participants was aware of the purpose of the experiment. After the experiment, everyone was paid for his or her participation.

3.1.2 Stimuli and apparatus

The stimuli and apparatus were the same as in Experiment 1.

3.1.3 Procedure

The procedure of the priming task was the same as in Experiment 1 except that no forced-choice prime visibility test was conducted within each trial. Instead, it was carried out at the end of the whole priming experiment.

After the whole priming task, all participants were asked to report whether they could see anything displayed before the masking stimulus. Then, a forced-choice visibility test was carried out. First, a central fixation was presented for 200 ms. Then, a word (tool or fruit word) appeared for 16 ms at the center of the screen, followed by a backward mask for a duration of 165 *ms*. Subsequently, two words, i.e., "tool" and "fruit", were presented.

Participants were asked to choose, or if they could not determine the prime word category, to guess the word category of the masked word by pressing the "1" or "2" key ("1" for fruit, "2" for tool) with the response- button assignment counterbalanced across participants. After participants made their choice, the next trial started 1,000 ms later. There were 52 forced-choice trials for each prime word category.

3.1.4 Design

The experimental design of Experiment 2 was the same as that of Experiment 1, except that the forced choice visibility test was given separately after the whole priming task was finished.

3.2 Results

3.2.1 Prime visibility results

Participants indicated that they could not detect the masked two-character words. In the forced-choice test, three participants had an accuracy rate above the chance level when considering each participant's overall average, so their data were excluded from the analysis. It is worth mentioning that the priming results with these three participants' data excluded were the same as those with their data included. For the remaining twenty-two participants, the mean percentage of correct recognition was 48.9%, *SE*=1.0%, not significantly different from chance level, t (21) = -1.020, p = .319. Nor was the *d*' value (mean = -.063, SE = .060) significantly different from zero, $t(21) = -1.040$, $p = .310$.

3.2.2 Unconscious priming effect

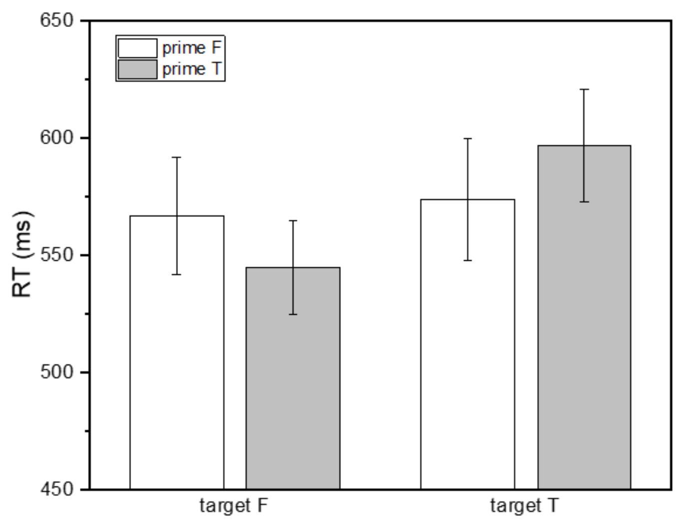

Figure 3. Mean response time (RT) of each condition in Experiment 2. Error bars represent standard errors of means. F represents "fruit" and T represents "tool".

The accuracies of the response to the target were submitted to a 2 (prime type: tool vs. fruit) × 2 (target type: tool vs. fruit) repeated-measures ANOVA. There were no significant main effects or interaction effects in accuracy, *Fs* < 2.432, *ps* > .134.

The same repeated-measures ANOVA on RTs as the one performed for the accuracy data showed no main effects of prime type, F (1, 21) = .002, p = .965, η_p^2 = .000. However, the main effect of target type was significant, F (1, 21) = 20.296, p < .001, η_p^2 = .491. The prime by target interaction was also significant, F (1, 21) = 17.423, p < .001, η_p^2 = .453. Simple effect analyses showed that when the target was a fruit, the RT for the congruent condition (fruit prime) (567 ms) was significantly longer than for the incongruent condition (tool prime) (545 ms), $F(1,21)$ = 4.70, p = .042. In addition, when the target was a tool, the RT for the congruent condition (tool prime) (597 ms) was also significantly longer than for the incongruent condition (fruit prime) (574 ms), $F(1,21)$ = 10.81, p = .004. Basically, the results revealed a negative compatibility priming effect in the context of the parameters used in this experiment (165 ms ISI between prime and target). A negative priming effect typically takes place when the ISI is long (Tipper 2001). These results are presented in

Figure 3.

4 Experiment 3

In Experiment 1, the presentation time of the backward mask was 163 ms, which produced a negative compatible priming as in Experiment 2. In most studies about unconscious priming, a long duration of the mask was not commonly used. In Experiment 3, the presentation time of the mask was adjusted to 50 ms, which was a parameter that fell within the scope of most unconscious priming studies and produced positive compatible priming. Also, more importantly, can the effect in Experiment 1 be extended to other types of stimuli? In Experiment 3, we changed words into simple arrow symbols to study whether the prime and target would affect the forced-choice response in the visibility test and whether the unconscious priming effect would be affected by the forced-choice task as in Experiment 1.

4.1 Methods

4.1.1 Participants

Thirty healthy, right-handed volunteers (mean age=21.7 years, SD =2.5 years) were recruited. They had a normal or corrected-to-normal vision. There was no participants' reported history of, or current neurological or psychiatric conditions. The research was approved by the local ethics committee. The participants gave their informed consent before the experiment. None of the participants was aware of the purpose of the experiment. After the experiment, everyone was paid for his or her participation.

4.1.2 Stimuli, Procedure and Design

The stimuli consisted of two pointing arrows.

The procedure was same as that in Experiment 1 except that the masked prime and the target were replaced by arrows. Therefore, in the forced-choice visibility test, the participants had to choose whether the masked arrow pointed left or right. In addition, the backward mask lasted for 50 ms instead of 163 ms allowing for a potential positive unconscious compatible unconscious priming effect to emerge.

There were four experimental conditions based on the forms of the matching arrangements between the prime and the target arrows: LL, LR, RR, and RL (L indicates an arrow pointing left and R an arrow pointing right). In each notation, the left capital letter denoted the pointing direction of the prime arrow, and the right capital letter the direction of the target arrow. The above four conditions were used to analyze the influence of prime and target arrows on the response in the forced-choice visibility test. To investigate the unconscious priming effect of the masked prime arrow on the response to the target arrow, the above four conditions were collpased into two conditions, e.g., congruent and incongruent conditions, based on the pointing relation between the prime and target arrows.

4.2 Results

4.2.1 Prime visibility

All participants reported that they could not detect the masked arrow. All 30 participants performed at the chance level in the forced-choice visibility test when considering the overall average of each participant. The mean percentage of correct recognition was 49.5%, not significantly different from the chance level, $t(29) = -.704$, SE=.8%, $p = .487$, nor was the d' value significantly different from zero, $t(29) = -1.002$, $p = .325$.

The accuracy data of the forced-choice visibility test were submitted to a 2 (direction of the prime arrow: left vs. right) × 2 (direction of the target arrow: left vs. right) repeated-measures ANOVA. The results showed no main effect of the direction of the prime arrow, $F(1,29) = 1.048$, $p = .315$, $\eta_p^2 = .035$, nor of the direction of the target arrow, $F(1,29) = .543$, $p = .467$, $\eta_p^2 = .018$. The interaction was also not significant, $F(1,29) = .084$, $p = .775$, $\eta_p^2 = .003$.

In theory, if participants were not aware of the masked arrow, they should perform at the chance level in each condition of the forced-choice task, not just in the overall accuracy. Although the above analysis did not show the effect of the direction of the prime arrow, we observed that the response in the visibility test tended to be contrary to the target arrow's direction in some participants but consistent with target arrow's direction in some other participants when we inspected the accuracy in each condition. This phenomenon was demonstrated in **table 3**. The fact that there was no participant whose accuracies in all conditions were all above or below the chance level (see the accuracies of all conditions of all participants in the **supplementary table 1**) excluded two explanations, i.e., "responses consistent with the prime" and "responses contrary to the prime".

Therefore, there were only two possible explanations left, i.e., "responses consistent with the target" and "responses contrary to the target".

If the response principle was "responses consistent with the target", the accuracy in LL and RR conditions would be high and the accuracy in LR and RL conditions would be low (light gray in **Table 3**) which was the case in ten participants. Second, if the response principle was "responses contrary to the target", the accuracy in LR and RL conditions would be high and the accuracy in LL and RR conditions would be low (dark gray in **Table 3**) which was the case in six participants. Most of the remaining fourteen participants performed above or below the chance level in some conditions although their results did not comply with the above patterns. It seemed that these participants adopted multiple strategies.

Table 3. Possible response patterns in the forced-choice visibility test that could lead to higher or lower than 50% accuracy in each condition.

Response Patterns Four Conditions	**LL**	**LR**	**RR**	**RL**
Possible responses making for higher than 50% accuracy	consistent with prime	consistent with prime	consistent with prime	consistent with prime
	consistent with target	Contrary to target	consistent with target	Contrary to target
Possible responses making for lower than 50% accuracy	Contrary to prime	Contrary to prime	Contrary to prime	Contrary to prime
	Contrary to target	consistent with target	Contrary to target	consistent with target

By checking the data of the forced-choice task in Experiment 1, there were seven participants whose accuracy in LR and RL conditions was higher than chance level and whose accuracy in LL and RR conditions was lower than chance level, but there was no participant whose accuracy in LL and RR conditions was higher than chance level and whose accuracy in LR and RL conditions was lower than chance level. This was indicative of a tendency of making a response contrary to the target category in the forced-choice visibility test. In addition, when the forced-choice visibility test was conducted separately from the priming experiment in Experiment 2, we found cases where no matter what the masked word was, some participants tended to make one same response. This was another strategy participants used to reduce the cognitive load.

4.2.2 Unconscious Priming effect

The accuracy and RT for the target response of the congruent and incongruent conditions were submitted to a paired *t* test. The results showed that the accuracy did not differ significantly between the two conditions (97.6% in the congruent condition vs. 97.0% in the incongruent condition), $t(29) = 1.359$, $p = .185$, Cohen's d = .248. However, the RT in the incongruent condition (529 ms) was significantly slower than that in the congruent condition (517 ms), $t(29) = -2.894$, $p = .007$, Cohen's d = .528. In short, the results showed a positive unconscious compatible priming effect.

5 Discussion

In Experiments 1 and 3, using a masking paradigm with different types of stimuli, we investigated whether the prime and target affected the participant's selection of an answer to what the masked prime was in the forcedchoice visibility test when the forced-choice task was performed immediately after the response to the target within each trial. We demonstrated a case of a response sequential effect in which participants tended to either repeat or reverse a response they made to the target in the forced-choice prime visibility test that followed the target identification immediately.

If the prime and target did not affect the performance on the forced-choice visibility test, the accuracy rate of the forced-choice task would be at the chance level. However, that was not the case in Experiment 1 when considering the possible impact of the categories of prime and target words on the forced-choice response.

If the prime word (assuming it was somewhat visible) affected the judgment in the forced-choice task, the participant's accuracy in the forced-choice task would be higher than the chance level. However, from the data in

Figure 2, the accuracies of FF and TT conditions were lower than the chance level. The best explanation for the forced-choice visibility test results in Experiment 1 was that the participant's responses were affected by the target word such that participants tended to avoid repeating the same response in the forced-choice test they made in the target identification.

In Experiment 1, in all the four conditions in which the correct responses in the forced-choice task were supposed to be based on the category of the prime, or random if there was no visibility of the prime, the forcedchoice test results reflected a tendency of making a response contrary to the target category. For example (see **Figure 2**), in the TT condition in which the prime and target were both tools, the correct response in the forcedchoice test should be "tool". However, the mean accuracy (.39) indicated that the majority of responses was "fruit", opposite of the target category (tool). In the FT condition in which the prime was fruit and the target was tool, the correct response in the forced-choice test should be "fruit" consistent with the rate of this response (.63), but again this was the opposite of the target category (tool). The same response pattern appeared in the other two conditions FF (.44 of fruit response), and TF (.55 of tool response). We have demonstrated in the analysis, that in cases where the prime and target were of opposite categories, the higher accuracy response rates were a function of the target, not of the prime. Taken together, in the visibility test of Experiment 1, participants tended to respond contrary to the target category when the forced-choice test was conducted immediately after the response to the target within each trial. It is worth noting that, when one looks at the overall average, one gets a false impression that the visibility test response is at a chance level. In addition, the analyses on the reverse-target and "F" responses showed that there was a significant target-type effect but no prime-type effect (see **Tables 1** and **2**). It seems that participants were likely doing this to reduce the high cognitive load of random guessing. Producing random information or actions was found to demand a considerable amount of attention (Robbins et al., 1996).

The same tendency of making a response in the forced-choice task contrary to the target was found in some participants in Experiment 3. However, it also revealed a tendency of making a response consistent with the target in some participants. And some participants seemed to adopt multiple strategies. We speculated that processing of arrows as in Experiment 3 might have demanded lower cognitive resources than processing of words as in Experiment 1, which led to a change of the response strategy in the forced-choice task across the two experiments.

In Experiment 2, there was a faster target identification time for fruits (556 ms) than for tools (586 ms), $t(21) = 4.465$, $p < .001$. We assume that this was because people have a more positive feeling for fruits than for tools (Nosek & Banaji, 2001). This assumption is also consistent with an overall higher rate of "fruit" response (.54) than of a "tool" response (.47) in Experiment 1's forced-choice visibility test (see **Figure 2**), although the difference was not significant, $t(24) = 1.063$, $p = .299$.

Surprisingly, there was no unconscious priming effect in Experiment 1, given that many previous studies have observed a priming effect of the word category when the prime visibility test was conducted separately at the end of the whole priming task experiment (Dienes et al., 1995; Kiefer & Brendel, 2006). We hypothesize that the forced-choice task inserted in each trial might have prevented the unconscious priming in Experiment 1. This might be especially the case when the random guessing in the forced-choice task incurred a high cognitive load. This hypothesis was supported in Experiment 2 when the visibility test was given at the end of the experiment. In fact, there was evidence that attention could affect the occurrence of unconscious priming (Kiefer & Brendel, 2006). Now that there is evidence that the response in the forced-choice task could be influenced by the target when the forced-choice task was given in each trial, perhaps the visibility test should be preferably conducted at the end of the experiment, regardless of whether such a visibility test can affect the results of unconscious priming. However, there might be an exception to this caveat where the choices in forced-choice task were clearly unrelated to the target stimuli as in Van Opstal, Gevers, Osman, & Verguts' (2010) study in which the prime was two numbers and the target was two colored patches.

We suggest that the phenomenon we reported here is a version of the response sequential effect found in other domains (Laming, 1997; Stewart et al., 2005). It is also consistent with the notion of inhibition of return in attention orientation (Posner et al., 1985). This type of response tendency may have an evolutionary basis and adaptive values (Klein, 1988; Klein & MacInnes, 1999).

Based on the above explanations, it is suggested that when using the forced-choice test to evaluate the visibility of the prime stimuli, it may be safer to conduct the forced-choice test and the priming task separately to avoid the influence of target on the response in the forced-choice visibility test. However, this is not a cure-all measure, because in Experiment 2 in which the forced-choice visibility test was conducted separately from the priming experiment, some participants tended to make one same response. From another point of view, using the above strategies in the forced-choice task can be seen as a helpless move, which indirectly supports the unconsciousness to the masked stimulus. Furthermore, although there were cases where the priming effect was observed when the visibility task was conducted in each trial (Finkbeiner & Palermo, 2009; Peremy & Lamy, 2014), possibly due to specific factors such as experimental designs, stimulus types as in Experiment 3, among others. We would like to emphasize that researchers should be aware of this potential issue when conducting unconscious priming experiments, especially when unconscious priming effects fail to occur.

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