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Investigating the Impact of Subliminal Perception on Decision-Making: An Experimental Study

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Abstract: The term “subliminal” is derived from Latin, meaning "below the threshold"—referring to stimuli that are not consciously perceived. Subliminal stimuli are sensory inputs presented below an individual's threshold of conscious awareness. In the present study, an experiment was designed using PsychoPy, an open-source platform based on Python for conducting psychological experiments. A within-group experimental design was employed, involving 75 participants selected through purposive sampling. Findings revealed a clear relationship between subliminal image presentation and participants' decision-making. Participants demonstrated a significantly higher number of correct responses for images with subliminal cues compared to the control images. However, no significant difference was observed between responses to dual-modality stimuli (i.e., symbol plus text) and those containing only symbols. Additionally, results suggested that participants retained subliminally presented material and, with repeated exposure, exhibited signs of learning across successive trials

Keywords: Subliminal perception, PsychoPy, dual modality, unconscious processing, cognitive psychology, visual priming.

Introduction

The scientific exploration of perception has long been central to understanding human cognition and reality. Within this domain, subliminal perception has garnered significant interest due to its paradoxical nature. The term “subliminal” is derived from Latin, meaning “below the threshold,” which implies a stimulus too weak to be consciously perceived. However, the notion of “subliminal perception” appears contradictory, as perception traditionally presupposes that a stimulus is sufficiently intense, sustained, and attention-capturing to enter conscious awareness (Mladenović et al., 2016).

Researchers have attempted to connect subliminal stimuli with the psychoanalytic concept of the unconscious (Freud, 1915). In studying subliminal perception, two key concepts are often referenced: **subjective** and **objective thresholds**. Objective thresholds are measured using forced-choice methods, where participants

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identify a stimulus (e.g., an image or word like “chair”) from a set of options after brief exposure. When accuracy falls to the level of chance, the stimulus is said to fall below the objective threshold. Conversely, the **subjective threshold** is determined by the point at which individuals report being unaware of the stimulus, even if they perform above chance. Research by Cheesman and Merikle (1984), as well as Merikle, Smilek, and Eastwood (2001), has shown that the subjective threshold is generally higher than the objective threshold by approximately 40 milliseconds.

McConnell et al. (1958) argue that stimuli closer to the threshold of consciousness are more likely to influence behavior. Yet, identifying a universal threshold remains challenging, as it varies significantly across individuals. The effectiveness of subliminal stimuli thus depends on two conditions: first, the stimulus must be presented below the subjective or objective threshold, and second, the individual’s behavior must differ in its presence compared to its absence—demonstrating an effect without conscious awareness (Snodgrass et al., 2004).

Moore (1982, 1988) critiques past studies for failing to ensure that stimuli were genuinely below the perceptual threshold. Some stimuli may have been presented too far below the objective threshold, rendering them ineffective due to a complete lack of processing.

Subliminal stimuli are defined as sensory inputs that fall below the conscious threshold of awareness. They may be briefly flashed or masked to prevent conscious recognition (Wikipedia). Importantly, perception without awareness should not be equated with subliminal perception. The latter refers specifically to instances where a stimulus is too weak for conscious recognition, yet still exerts an influence on behavior (Dewey, 2010).

The notion of an "objective threshold" is itself contested. According to IResearchNet (2016), no single threshold governs conscious awareness, as perceptibility depends on a variety of individual and contextual factors—rendering the threshold inherently subjective.

Subliminal messages generally involve three components: the subliminal stimulus itself, its perception, and subsequent processing. When these three elements align, the message bypasses conscious awareness but is still encoded as sensory information, ultimately influencing an individual's decisions and behaviors (Valenzuela, 2022).

Methodology

1.1. Study Problem:

The present study investigated the relationship between subliminal image presentation and decision-making among participants. Specifically, it examined whether subliminally presented visual stimuli influence participants' selection of image-associated options.

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1.2. Variables:

Independent Variable:

- Presentation of the pictures:
    a. Without the subliminal stimulus.
    b. With the subliminal stimulus presented for 0.2 seconds.

Dependent Variable:

- Number of correct responses in the experimental pictures.

Control Variable:

- Type of laptop used
- Sitting position
- Experimental environment

Extraneous variable:

- Individual differences in conceptual understanding.
- Individual threshold difference in perception.
- External noise
- Screen brightness

1.3. Hypothesis:

H1*: The number of correct responses in the experimental pictures will be significantly higher than the random responses in the control pictures.*

H2*: The number of correct responses will be significantly higher for pictures with subliminal stimuli containing both symbols and text, compared to those containing only symbols.*

1.4. Respondents:

Participants were selected using the **Purposive Sampling Method**, a non-probability sampling technique. The sample consisted of 75 postgraduate students from the Department of Psychology, Maharaja Sayajirao University of Baroda, most of whom were aged between 21 and 25 years. Purposive sampling was deemed appropriate for this study to ensure the inclusion of individuals with relevant academic backgrounds and adequate understanding of visual and cognitive psychological constructs. The selection criteria enhanced the likelihood of participants engaging meaningfully with the experimental content.

1.5 Procedure and Instruments

The experiment was conducted using **PsychoPy**, an open-source software widely employed in psychological research for designing psychophysical tasks with high temporal precision. PsychoPy served as the primary data collection instrument, allowing the presentation of controlled stimuli and the recording of participant

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responses via keyboard inputs. Its flexibility and compatibility with Python made it well-suited for academic experimentation requiring custom trial designs.

Each participant completed the task individually on a separate laptop in a distraction-free environment to minimize potential confounding influences. Upon reading the on-screen instructions, participants were exposed to a sequence of eight animated images, each displayed for 6.5 seconds. These images were equally divided into two categories:

- **Experimental Pictures (n = 4)**: Included a subliminal stimulus (a symbol or logo) presented for **0.2 seconds**, inserted between two 3-second segments of the same visual scene.
- **Control Pictures (n = 4)**: Contained no subliminal stimuli and were used to elicit baseline responses without any embedded cue.

Following each image, participants were presented with **four multiple-choice options**, one of which was conceptually linked to the subliminal cue (in the experimental trials). Examples of the subliminal pairings included:

- A couple seated in a café with a **broken heart symbol**, corresponding to the option *"Breakup"*.
- A woman carrying shopping bags paired with the **Adidas logo**, corresponding to *"Adidas"*.
- A man in formal attire accompanied by the **SBI logo**, corresponding to *"SBI"*.
- A doctor image containing a **heart with an ECG line**, corresponding to *"Cardiologist"*.

In the **control condition**, no subliminal images were embedded, and thus no correct option was predetermined. Participant choices in these trials were expected to be random, providing a comparative baseline.

The experiment followed a **within-subject design**, whereby all participants were exposed to both experimental and control conditions in alternating sequence. This approach allowed for intra-individual comparisons and controlled for individual differences in perception and cognitive processing. Participants registered their responses using designated keyboard keys.

To complement the quantitative data, an **introspective questionnaire** was administered post-experiment. This qualitative measure captured participants' subjective strategies, perceptual impressions, and any awareness of stimuli during the trials.

Before implementing the final version of the experiment, **eleven pilot studies** were conducted. These were instrumental in refining the visual clarity of images, optimizing stimulus placement and timing, and evaluating the visibility of subliminal cues. Additionally, based on pilot feedback, the experimental design was modified from a between-subject to a within-subject format, thereby enhancing the reliability and control of the procedure.

1.6 Research Design

This study employed a **quantitative, within-subject experimental design**. Each participant was exposed to both control and experimental conditions, allowing comparison within the same individuals. The design aimed to determine whether exposure to subliminal stimuli affected the accuracy of participant decision-making.

1.7 Data Analysis

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Data collected through PsychoPy was analyzed using **JASP (Version 0.16.3)**. Descriptive statistics (frequencies and percentages) were used to summarize response distributions. **Chi-square tests for independence** were performed to evaluate whether the distribution of choices in control vs. experimental conditions deviated from random chance. A significance threshold of $p < .001$ was adopted to interpret results.

Result & discussion

After the conduction of the experiment, the data was analyzed in the JASP software. The results are assimilated and explained below.

Contingency Table For Control Pictures						
		Options				
Picture		O1	O2	O3	O4	Total
P1	Count	24	24	10	17	75
	% within row	32.000 %	32.000 %	13.333 %	22.667 %	100.000 %
P2	Count	21	24	8	22	75
	% within row	28.000 %	32.000 %	10.667 %	29.333 %	100.000 %
P3	Count	34	22	15	4	75
	% within row	45.333 %	29.333 %	20.000 %	5.333 %	100.000 %
P4	Count	9	21	19	26	75
	% within row	12.000 %	28.000 %	25.333 %	34.667 %	100.000 %

Table– 1. Displays the frequency of the preference of options from one to four in all four pictures presented in the trials with no subliminal stimuli on Psychopy software.

Contingency Table For Experimental Pictures						
		Options				
Picture		O1	O2	O3	O4	Total
P1	Count	6	1	53	15	75
	% within row	8.000 %	1.333 %	70.667 %	20.000 %	100.000 %
P2	Count	5	9	56	5	75

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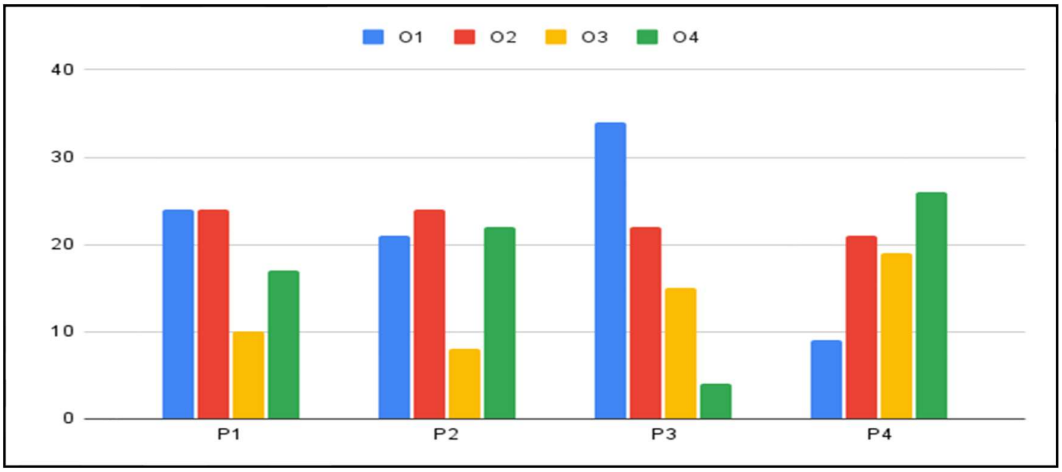
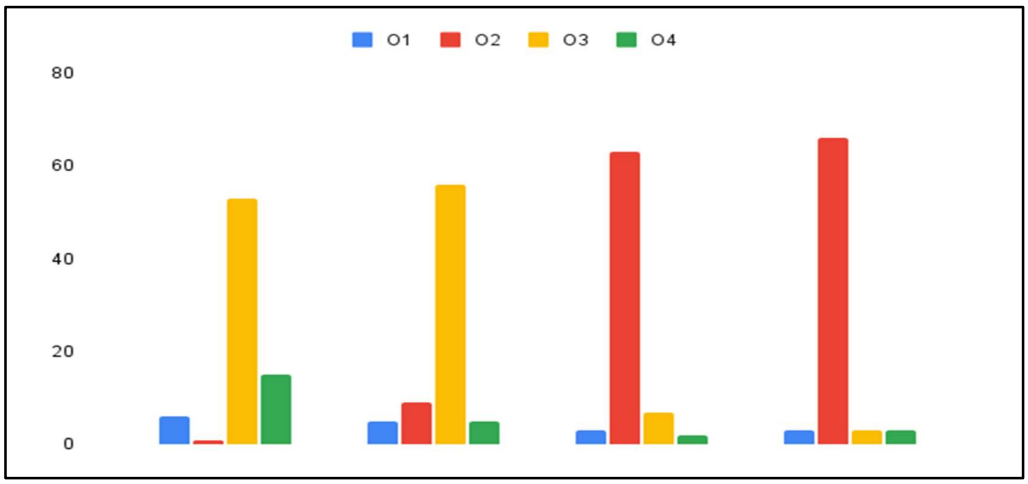
	% within row	6.667 %	12.000 %	74.667 %	6.667 %	100.000 %
P3	Count	3	63	7	2	75
	% within row	4.000 %	84.000 %	9.333 %	2.667 %	100.000 %
P4	Count	3	66	3	3	75
	% within row	4.000 %	88.000 %	4.000 %	4.000 %	100.000 %

Table– 2. Displays the frequency of preference of options from one to four in all four pictures which were presented in the trials along with the subliminal stimuli on Psychopy software.



Graph 1. Frequency of preference of one from four offered pictures of control pictures in trials



Graph 2. Frequency of preference of one from four offered pictures of experimental pictures in trials

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Results and Interpretation of Control and Experimental Trials

The results presented in Table 1 and Graph 1, which pertain to the control condition, demonstrate that in the absence of subliminal stimuli, participants selected options in a random distribution. The frequency of responses across the four options varied considerably, ranging from approximately 12% to 45% for different images. These results establish a baseline for comparison with the experimental condition and indicate no consistent response pattern, as expected in trials where no subliminal cues were embedded.

In contrast, the findings illustrated in Table 2 and Graph 2 (experimental condition) reveal a distinctly non-random distribution of responses. For each image containing subliminal stimuli, more than **70% of participants selected the intended target option**, which was designed to correspond with the subliminal cue. These trends suggest a meaningful influence of subliminal exposure on participants' decision-making processes.

Picture 1 (Café Couple – Broken Heart Symbol)

Out of 75 participants, **53 participants (70.66%)** selected **Option 3: "Breakup"**, which was aligned with the subliminal cue—a broken heart symbol flashed for 0.2 seconds. Introspective responses revealed that participants frequently referred to symbols such as "heartbreak symbol," "heart sign," or "broken heart," indicating perceptual processing of the subliminal stimulus. Conversely, a minority who selected other options cited impressions like "sitting apart," "focused on the plus sign," or "sitting casually," suggesting that their choices were guided by conscious, but unrelated, visual details.

Picture 2 (Shopping Scene – Adidas Logo)

In this trial, **56 participants (74.66%)** chose **Option 3: "Adidas"**, corresponding to the Adidas logo briefly displayed during the image sequence.
Many participants who selected the correct answer reported strategies such as "saw the Adidas logo," "image flashed," and "noticed something in peripheral vision." A small subset, who selected alternative responses, indicated reasoning based on brand familiarity, personal associations, or assumptions derived from clothing styles (e.g., "brand linked to my name," "looked like an ad," etc.).

Picture 3 (Man in Suit – SBI Logo)

This image produced the strongest alignment, with **63 out of 75 participants (84%)** selecting **Option 2: "SBI"**, which matched the subliminally presented State Bank of India (SBI) logo.

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The introspective responses reinforced the behavioral data, with participants citing cues such as "SBI logo," "blue circle," or "SBI name." The remaining 16% who did not select the target option provided justifications related to the character's attire or general appearance (e.g., "formal clothes," "seemed like he works at a bank," "BOB has good staff"), suggesting they relied on conscious reasoning rather than subliminal cues.

Picture 4 (Doctor – Heart with ECG Line)

This image had the highest accuracy rate, with **66 participants (88%)** identifying **Option 2: "Cardiologist"**, directly corresponding with the heart and ECG icon presented subliminally.
Participants who selected the correct option frequently mentioned visual cues like "heart emoji," "heart flashed," or "ECG symbol," indicating successful subliminal processing. The few incorrect responders based their answers on facial expression or attire (e.g., "doctor was smiling," "looked like a neurologist," "peaceful demeanor"), implying no awareness of the embedded symbol.

Based on the findings presented in **Table 1** and **Table 2**, and the preceding analysis of response patterns, **Hypothesis 1 (H1)**—that the number of correct responses in experimental pictures would be higher than random responses in control pictures—has been **supported and accepted**.

A secondary focus of the study was the effect of **Dual Modality**, a concept adapted from the work of **Mladenović et al. (2016)**. According to the original findings, subliminal exposure to images was generally more impactful than text alone. In the present study, we examined whether **stimuli combining symbols with text** (dual modality) produced a stronger response than **symbols alone**.

To assess this, the four experimental images were categorized as follows:

- **Symbol-Only Subliminal Stimuli**:
    - **Picture 1**: Broken heart symbo
    - **Picture 4**: Heart with ECG line
- **Symbol + Text Subliminal Stimuli** (Dual Modality):
    - **Picture 2**: Adidas logo (with text)
    - **Picture 3**: SBI logo (with text)

These findings reveal that the **average correct response rate was identical (79.335%)** for both types of subliminal stimuli. Consequently, **Hypothesis 2 (H2)**—which proposed that pictures with **symbol + text** stimuli would elicit a significantly higher number of correct responses than pictures with symbols alone—has been **REJECTED**.

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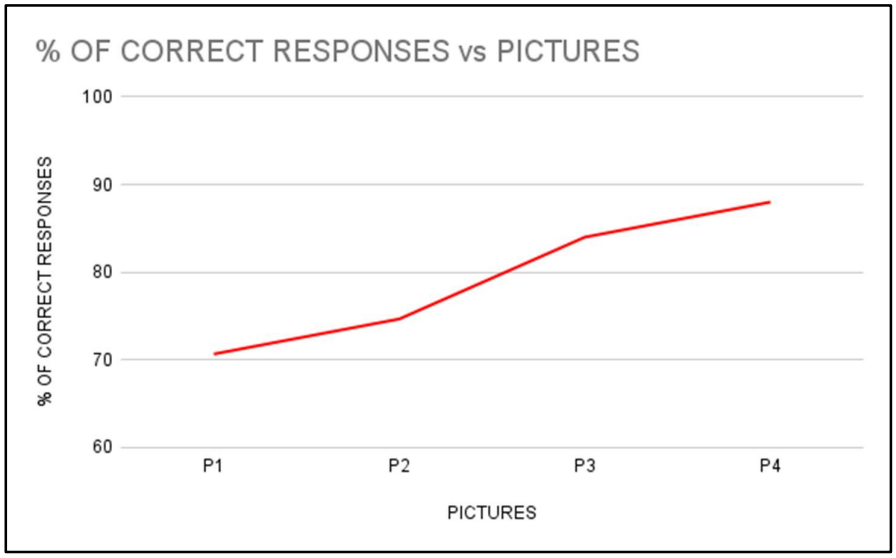
Observed Trend: Effect of Trial Progression

A noteworthy trend emerged during the experimental sequence: **the accuracy of responses appeared to increase with the progression of trials**. This suggests a possible learning or priming effect, whereby participants became more attuned to the subliminal cues as the experiment advanced.

This trend is presented in the following table:

PICTURES	% OF CORRECT RESPONSES
P1	70.667
P2	74.667
P3	84
P4	88

Table 3. Displays the increase in the percentage of the correct responses with the increase in the number of trials.



Graph 3. Graphical representation of the increase in the percentage of the correct responses with the increase in the number of trials.

Now, this trend observed shows that with an increased number of trials, the percentage of correct responses increases. The reason behind this can be the learning taking place in the subsequent trials, which was also noted in the introspective report, where subjects mentioned that as they moved forward to the later trials they came to know that something would pop up. This trend was already comprehended and hence a control picture was kept after every experimental picture, but still, the learning did take place in the subsequent trials.

Chi-Squared Tests

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Experimental/ Control		Value	df	p
Control	X^2	36.371	9	< .001
	N	300		
Experimental	X^2	204.378	9	< .001
	N	300		

Source: JASP Team (2022). JASP (Version 0.16.3) [Computer software].

Table-4. displays that there is a significant association between subliminal perception and the stimulus which has been shown in the pictures for 0.2 seconds.

Using the Chi-square test we examined the normality of the distribution of choice of pictures which were given by respondents in the experimental pictures, the results show that distribution statistically significantly varies from normal one (value = 204.378, df= 9, p<.001 N= 300). For control pictures we used the Chi-square test to examine the normality of the distribution of choice of pictures which were given by respondents in the control pictures, the results show that the distribution statistically significantly differs from the normal one (Value = 36.371, df=9, p<.001, N= 300). The result obtained showed that it is statistically highly significant as $P < 0.001$.

Conclusion

The findings of this study provide compelling evidence that subliminal visual stimuli can influence decision-making. Participants exhibited a significantly higher rate of correct responses in trials involving subliminal cues compared to control trials, thereby confirming the central hypothesis. This conclusion was statistically validated through Chi-square analysis, with results demonstrating a highly significant association ($p < .001$) between subliminal exposure and participant choices. Contrary to expectations, no meaningful difference was observed between the effectiveness of dual modality stimuli (symbols combined with text) and symbol-only stimuli, leading to the rejection of the second hypothesis. The identical average accuracy rates in both conditions suggest that symbolic subliminal cues alone are as effective as those supplemented with textual information in influencing participant behavior. Additionally, introspective data and response trends across the experiment revealed that participants increasingly recognized subliminal content as the trials progressed.

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This pattern indicates a possible learning or priming effect resulting from repeated exposure. Taken together, the results affirm that the methodological design and procedural controls implemented in this study were effective in isolating the variable of interest and ensuring data reliability. The use of PsychoPy as a stimulus delivery and response-recording tool, combined with a within-subject experimental structure and pretesting through pilot studies, contributed to the internal validity and robustness of the research. This study reinforces the psychological significance of subliminal perception and opens avenues for further exploration into its role in cognition, marketing, behavioral influence, and unconscious processing.

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