Ignorance is Bliss: On Measuring the Awareness of Subliminally Presented Stimuli

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Nonconscious Processing

That information processed outside awareness can affect downstream perceptions, judgments, and behaviors is widely accepted, even axiomatic, in many fields of psychology.

Seminal works in, for example, social (Fazio, 2001), emotional (Zajonc, 1980), and cognitive psychology (Kihlstrom, 1987), laid the foundation for a vast literature on the consequences of nonconscious processes.

Exploring Nonconscious Processing

Central to this research is minimizing the influence of conscious processing

- Often done so via subliminal presentations:
  - Short Durations
  - Masking
  - Continuous Flash Suppression

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Measuring Awareness of Subliminal Stimuli

Standard to ensure participants are unaware by conducting an awareness check using an awareness measure.

Common to see different awareness measures utilized between studies, e.g.,

- detection task

- alternative forced choice recognition task

- verbal reports

Are Different Measures all Measuring Awareness?

There is no established standard for what constitutes awareness.

This is reflected in measures that vary in their discrimination threshold (i.e., level of awareness needed for a correct response)

Which measure measures awareness?

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States of "Awareness"

Awareness is not an all-or-none phenomenon (i.e., one is totally aware or unaware), but a gradual process spanning nil to complete awareness, between which lay gradients of partial awareness (Lähteenmäki et al., 2015; Mangan, 2001; Sandberg et al., 2010).

'Awareness' can therefore refer to distinct levels along a continuum (i.e., states of awareness; Overgaard et al., 2005) which necessarily implies that different measures may tap different states.

Measuring Different States of "Awareness"

Subjective awareness requires a perceiver to classify the phenomenological experience or identify the stimulus unprompted

• No information provided to observer

Objective awareness requires that perceivers perform at above chance in some form of object detection or alterative forced-choice

• Some information provided to observer

The distinction between **subjective** versus **objective** awareness/ measures is in their **discrimination thresholds**; the state of awareness needed for correct response.

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So What's the Big Deal?

Ignoring the complexity of what is and measuring "awareness" create problems for research relying on presenting stimuli beyond awareness. Not a new issue.

But researchers have and continue to make claims of participant (un)awareness based on loose operationalizations of the concept "awareness" and idiosyncratic standards and practices for testing participant knowledge.

Two Challenges Common to Research Using Subliminal Presentations

1. The use of various awareness measures between studies makes it difficult to interpret claims about subliminality and participant unawareness within any given study.

   • Beyond the conclusions of one program of research, the atheoretical choice of measure makes moving the field forward difficult as extensions of prior work might not be sensitive to *how* awareness was previously measured.

Two Challenges Common to Research Using Subliminal Presentations

2. Awareness is undefined (or, perhaps, undefinable) if it is a relative standard characterized within the confines of the measure used to test for it.

    • If the operationalization of awareness is directly linked to how one chooses to measure awareness, it renders such tests as mere manipulation checks and says nothing about awareness per se.

How Do I Know This is a Problem?

Spoiler Alert: My attempts to measure participant awareness of different classes of subliminal stimuli (e.g., positive, neutral, negative, threatening) led to different conclusions about participant awareness.

Trial structure (i.e., stimulus duration, masking parameters) remained nearly constant, but changing the dependent variable modified the discrimination threshold (i.e., level of awareness needed for a correct response) between tasks.

So Here's What Happened to Me.

Study 1: Object Detection Task

Study 2: Alternative Forced Choice Tas

Study 3: Conscious Perception

All studies used the same stimuli (negative, neutral, positive, threat).

• Trials per stimulus category were equal in each study (25% per category)

• Stimuli presented on 144hz high-speed monitor
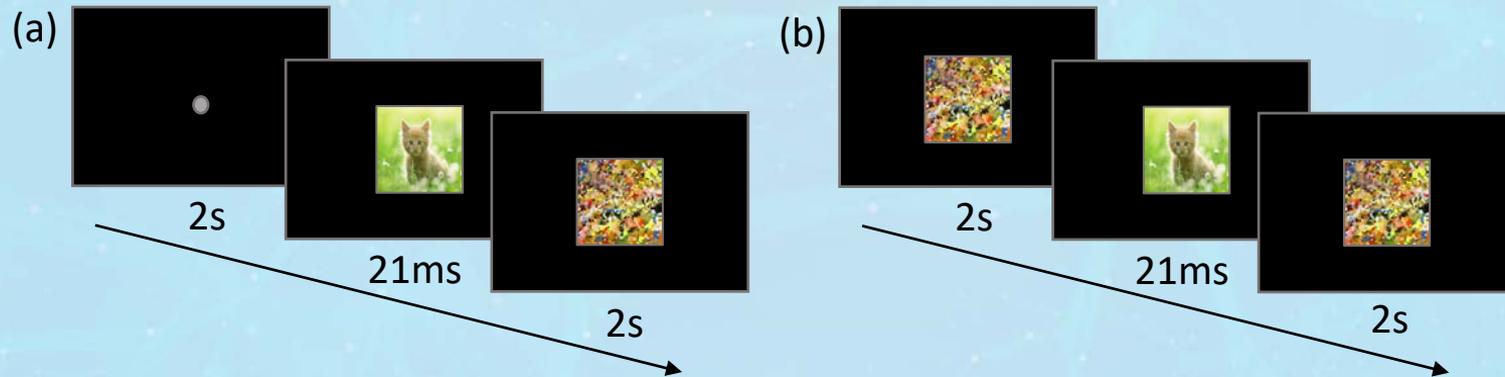
Two versions of each study

• (a) Pre- and post-mask (i.e., sandwich mask) versus (b) only post-mask

Study 1a and 1b: Object Detection Task

Study 1a (N=47) and Study 1b (N=135)

- Participants told that an image may be presented very quickly
  - 50% of 100 trials contained a stimulus
- Task was to indicate via keypress whether an image was presented

(a) 2s 21ms 2s

(b) 2s 21ms 2s

Study 1a and 1b: Object Detection Task

In detection tasks, people often evidence a bias towards responding with either yes or no. Therefore, I used signal detection analyses.

d': difference between probabilities of a hit in relation to a false alarm

c: bias toward saying yes or no on any given trial
- $c = 0$, no bias toward responding yes or no
- $-c$ indicates a liberal bias (i.e., more likely to say yes than no)
- $+c$ indicates a conservative bias (i.e., more likely to say no than yes)

a': analogous to d' but accounts for the correlated nature of d' and c (Stanislaw & Todorov, 1999)
- a' ranges from .5 (signal indistinguishable from noise) to 1 (perfect performance)

Study 1a and 1b: Object Detection Task

Table 1. Response metrics for Studies 1a and 1b

| Stimulus	Study 1a				Study 1b			
	% correct	d'	c	a'	% correct	d'	c	a'
Negative	35	0.9	.927	.637	35	.534	.956	.569
Neutral	47	1.25	.75	.708	41	.692	.877	.618
Positive	40	1.07	.850	.670		.526	.960	.577
Threatening	46	1.23	.770	.746	41	.69	.888	.607

- Poor to average guessers (<50%), driven by conservative bias toward saying no
- *a'* indicates better than chance, but driven by many correct noes

So, were people aware?

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Study 2a and 2b: Alternative Forced Choice

Study 2a (N=44) and Study 2b (N=80)

- Participants told an image would be presented very quickly
  - All 100 trials contained a stimulus

- Task was to indicate via keypress which image was presented

(a)   2s   21ms   2s   Till response

(b)   2s   21ms   2s   Till response

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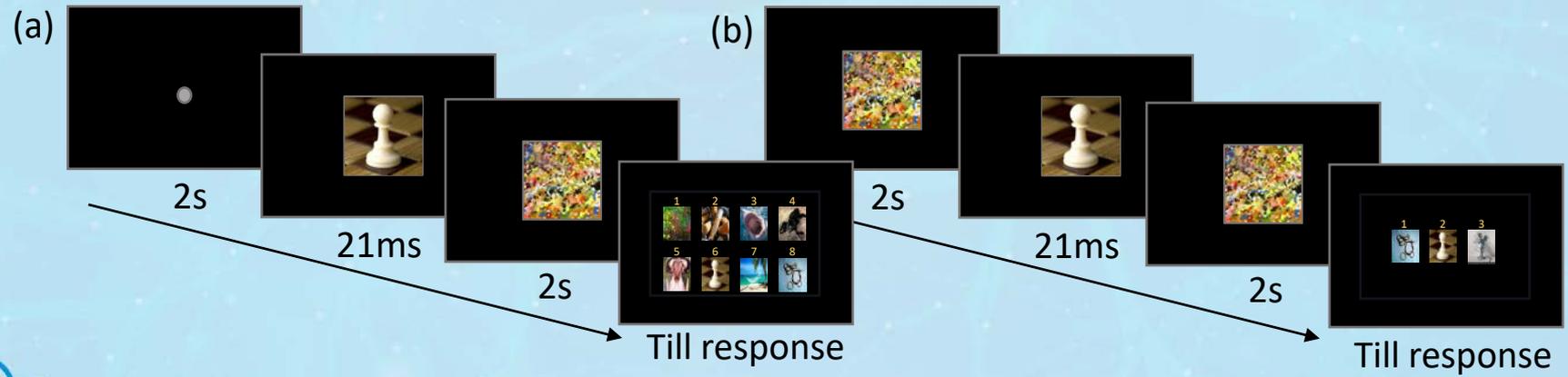
Study 2a and 2b: Alternative Forced Choice

Study 2a

Stimulus Category	Chosen Category			
	Negative	**Neutral**	**Positive**	**Threat**
Negative	11.6% (+ 5.6%)	30.3%	35.2%	17.4%
Neutral	11.0%	37.5% (+ 11.8%)	25.7%	14.0%
Positive	13.0%	31.4%	(19.0% + 16.2%)	19.8%
Threat	12.8%	24.0%	31.7%	(21.0% + 10.5%)

"I couldn't tell what any of the images were, just picked the pleasant ones."

Study 2b

Stimulus Category	% Correct
Negative	48.9%
Neutral	59%
Positive	54.3%
Threat	46.1%

Note: Chance is 33% correct

"I could not really see the images, but it was almost like I could see outlines for a split second after the image had passed."

So, were people aware?

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Study 3a and 3b: Conscious Perception

Study 2a (N=43) and Study 2b (N=50)

- Participants told an image would be presented very quickly
  - All 100 trials contained a stimulus

- Paid 1$ for every correct answer, no penalty for guessing
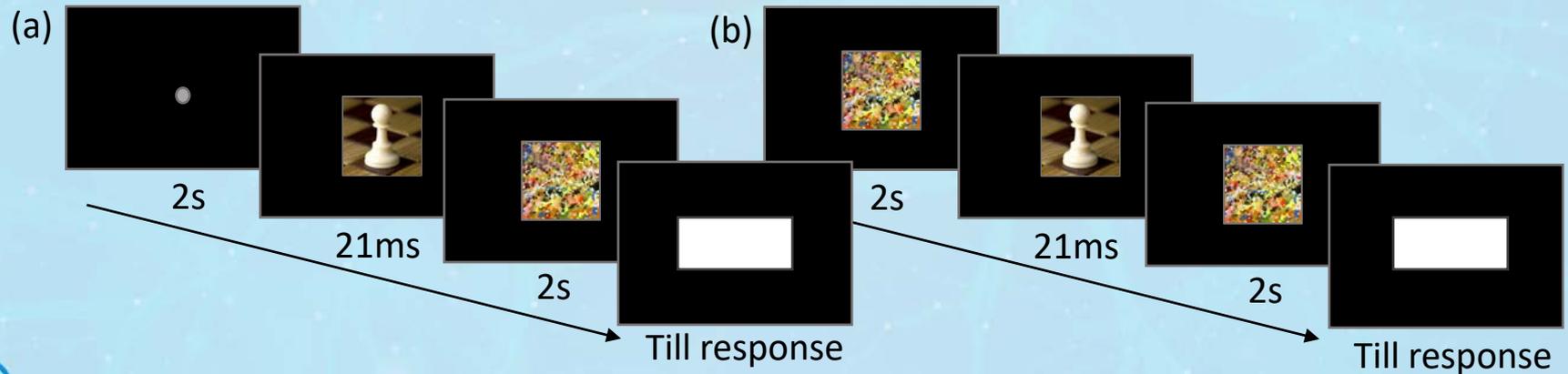
Study 3a and 3b: Conscious Perception

Research assistants blind to the research question scored participant responses for accuracy.

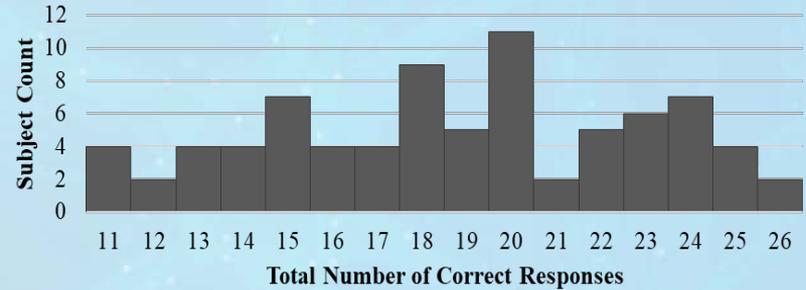| Stimulus	Study 3a			Study 3b		
	Don't Know	Incorrect Guess	Correct Response	Don't Know	Incorrect Guess	Correct Response
Negative	73%	26%	1%	80%	19.8%	0.2%
Neutral	48%	40%	12%	62%	26.3	1.7%
Positive	68%	26%	6%	80%	19.5%	.5%
Threat	60%	36%	4%	76%	23.7%	0.3%

So, were people aware?
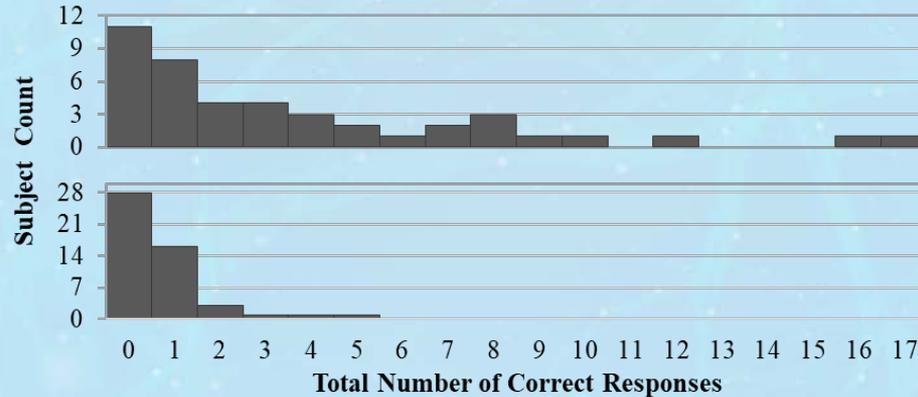
Idiosyncratic Ability

Studies 1a and 1b
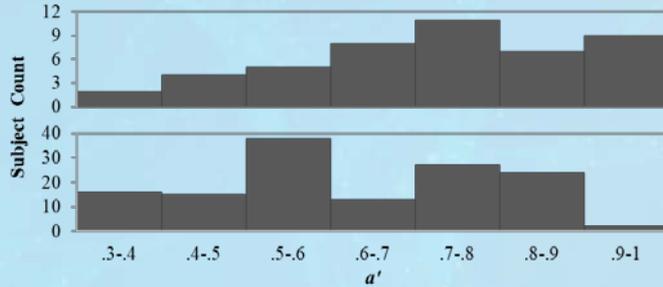
Study 2b

Studies 3a and 3b

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So, were people aware?

The results of the three studies point to different conclusion about awareness.

- Mean performance at chance for object-detection (Study 1a and 1b)
- Well above chance for forced-choice tasks (Study 2b)
- Performance suffered when awareness was measured as conscious perception (Study 3a and 3b)

Within studies, performance varied as a function of both the stimulus type and mask.

Across all studies, the most consistent trend involved neutral objects as more readily perceived as present, matched, and described than were objects from the other categories

So, what's the takeaway?

Defining "awareness" may be relative. No measure is "best".

The level of unawareness necessary and the appropriate way to measure awareness depends on one's research goals.

For example, if a research question requires that participants remain unaware of even the mere presence of a stimulus, a yes/no task is commensurate with such requirements.

Such liberal tests of awareness may be incongruent with the typical goal of some subliminal presentation – to keep stimuli below the threshold for *conscious* classification