Overview of the display durations used in studies investigating unconscious emotional stimulus processing. Table 1 shows studies who did a threshold validation for unconscious stimulus presentation using objective and/or subjective measures of awareness. Table 2 shows the studies who used a specific presentation duration without validation the respective presentation time to induce unconscious processing.

Table 1 Table with studies using and validating the presentation duration for subliminal affective priming.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Sample size** | **Stimulus** | **Duration** | **Method** | **Threshold validation done?** | **Finding** |
| Esteves and Öhman (1993) | HC: 30 | Target/Mask: angry, happy, neutral | Exposure time of target was gradually extended (from 10ms in 5ms steps) | Backward mask task  Objective measure: task performance at chance level  Subjective measure: (1) When the subject reported that something more than just one face could be seen. (2) when the subject made a correct guess, and (3) when the subject asserted that he or she was sure of the attribute. | Yes | “Confident recognitions of facial expressions required about 100ms-150ms SOA”  Objective threshold happy = 30ms-50ms SOA  Subjective threshold happy = 50ms-80ms SOA  Subjective threshold angry = 120ms-170ms SOA |
| Pessoa et al. (2005) | HC: 11 | Target: fearful, happy, neutral  Mask: neutral | 17ms, 33ms, 83ms | Backward mask task (forced-choice fear-detection task)  Objective measure: task performance, characterized (includes hit rate and false alarm rate) | Yes | Subjects are able to detect briefly presented stimuli presented for 33ms |
| Whalen et al. (1998) | HC: 10 | Target: fearful, happy, neutral  Mask: neutral | 33ms | fMRI, Backward mask task  Subjective measure:  (1) Subjects were asked to describe  presented faces and comment on the  emotional expressions of the faces.  (2) They were asked if they had seen any happy, fearful or afraid faces.  (3) Subjects were shown all face stimuli  (fearful, happy, and neutral) and asked to point out the specific faces  they had referred to in response to earlier questions. | Yes | Two of the 10 subjects indicating that they had seen features of the emotional target stimuli. |
| Rauch et al. (2010) | Not reported | Target: happy, sad, neutral  Mask: neutral | 33ms | Detection task  Objective measure: performance accuracy (chance level) | Yes | “The chance level for correct answers was 25%.” |
| Suslow et al. (2010) | HC: 26  MDD: 30 | Target: happy, sad, neutral, no face  Mask: neutral | 33ms | Detection task  Objective measure: average sensitivity taking into account hit rate and false alarm rate  Subjective measure: participants report if they recognized any brief presented emotional faces | Yes | “All subjects reported that they had not recognized any briefly presented emotional faces, even after being informed about their presence”  Measure of sensitivity indicating chance level |
| Suslow et al. (2009) | HC: 51 | Target: happy, sad  Mask: neutral | 33ms | Detection task  Objective measure: performance accuracy (chance level) | Yes | “The chance level for correct answers was 25%.” |
| De Pascalis et al. (2020) | HC: 10 | Target: happy, sad, neutral  Mask: purple or yellow images | 10ms, increased in 10ms steps | Detection task  Subjective measure: subjects reported when they saw a face-like shape | Yes | Subjective threshold ranged between 20ms and 60ms (mean of 45.8ms.)  Author concluded to use 21ms for subliminal priming |
| Zhang et al. (2016) | HC: 26  MDD : 26 | Target: sad, happy, neutral | 17ms | Backward mask task  Objective measure: hit rates and false alarm rates, performance at chance level | Yes | Detection accuracy was at chance level for both groups |
| Hedger et al. (2019) | HC: 41 | Target: neutral, fearful, happy | 17ms | Backward mask task  Objective measure: hit rates and false alarm rates, performance at chance level | Yes | “Masked presentations showed poor discrimination between signal and noise.” |
| Lojowska et al. (2019) | HC: 24 | Target: grating orientation | 16.7ms | Backward mask task  Objective measure: performance at chance level (50% correct) | Yes | Performance at chance level in masked trials |
| Neath and Itier (2014) | HC: 49 | Target: neutral, disgust, fearful, happy, surprised  Mask: inverted neutral | 16.7ms, 50ms, 100ms | Eye tracking, Backward mask task  Objective measure: performance accuracy (hit rate and false alarm rate) | Yes | No emotion discrimination differences were found in the 16.7 condition. |
| Milders et al. (2008) | task 1  HC: 14  task 2  HC: 20 | Target: fearful, angry, happy, neutral  Mask: neutral (task1), black and white checkerboard pattern (task2) | 10ms, 20ms, 30ms, 40ms, 50ms | Backward mask task  Objective measure: task performance  Subjective measure: subjective awareness rating | Yes | Mean sensitivity was above chance at presentation times of 20ms.  Awareness ratings exceeded baseline rating from 20ms onwards.  “The results support the possibility of incomplete masking in earlier studies” |
| Kiss and Eimer (2008) | HC: 14 | Target: neutral, fearful  Mask: scrambled face | 8ms | EEG, Backward mask task  Objective measure: task performance | Yes | Identification performance was at chance level |

HC= healthy controls, MDD= major depressive disorder

Table 2 Table with studies using specific durations for subliminal affective priming but did not validate the presentation duration for unconscious awareness.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Sample size** | **Stimulus** | **Duration** | **Method** | **Threshold validation done?** | **Finding** |
| Esteves et al. (1994) | HC: 40 | Target: angry, happy  Mask: neutral | 30ms | Backward mask task | No, reason for timing decision:  Esteves and Öhman (1993) | No SCR difference between masked (60ms) and unmasked (30ms) trials when attention is manipulated.  “Some controlled processing seems to be possible” |
| Stuhrmann et al. (2013) | HC: 35  MDD: 35 | Target: sad, happy, neutral  Mask: neutral | 33ms | fMRI, subliminal affective priming paradigm | No, reason for timing decision:  Dannlowski et al. (2010); Rauch et al. (2010); Suslow et al. (2010); (2009) | “Depressed patients showed greater amygdala responses to sad than happy faces, compared to healthy controls” |
| Dannlowski et al. (2010) | HC: 44 | Target: happy, sad  Mask: neutral | 33ms | fMRI, subliminal affective priming paradigm | No, reason for timing decision:  Ekman (1976) | “5-HTTLPR genotype differentially modulates amygdala responses for negative and positive emotional content” |
| Victor et al. (2010) | HC: 25  dMDD : 22  rMDD : 25 | Target/Mask: sad, happy, neutral | 26ms | fMRI, Backward mask task | No, reason for timing decision:  Esteves and Öhman (1993); Wiens et al. (2004)  Note: Wiens are just testing technical issues like screen type (LCD and TFT presentations had poor accuracy, but shutter and CRT) | “dMDD participants showed greater amygdala  responses than HCs to masked sad faces” “These data demonstrate that negative emotional-processing biases occur automatically, below the level of conscious awareness” |
| Zhang et al. (2020) | MDD: 31  HC: 28 | Primer: words  Target: angry, happy | 20ms | Priming task | No, reason for timing selection: None | “Findings suggest a ductility of inhibitory control in depression using subliminal priming “ |
| Killgore and Yurgelun-Todd (2004) | HC: 12 | Target: Sad, happy  Mask: neutral | 20ms | fMRI, Backward mask task | No, reason for timing selection: (Esteves & Öhman, 1993) | BOLD difference between masked happy faces and masked sad faces. |
| Suslow et al. (2003) | 4 groups with 30 each | Target: happy, sad, neutral  Mask: ideograph | 16.7ms | Backward mask task | No, reason for timing selection: Murphy and Zajonc (1993) | “An hedonic and flat affect patients but not patients without affect symptoms were found to be sensitive to negative facial affect on an automatic processing level” |
| Cai et al. (2020) | HC: 105 | Target: words | 16ms | Priming task | No | 17 Participants could identify subliminal stimuli |
| Peng et al. (2016) | HC: 16  IGD: 16 | Target: neutral, happy, sad  Mask: scrambled face | 17ms | EEG, Backward mask task | No, reason for timing selection: (Esteves & Öhman, 1993; Zhang et al., 2016) | “behavioral data revealed that groups responded faster to unconscious emotional expressions (happy and sad expressions) than to neutral expressions” |
| Flynn et al. (2017) | HC: 9 | Target: black and white chatterbox  Mask: scrambled image | 7ms | EEG, Backward mask task | No, reason for timing selection: Mixed results from earlier studies using time above 7ms | “Results showed that for stimuli that were effectively masked at 7ms presentation, there was little variation in the ERPs” |

HC= healthy controls, MDD= major depressive disorder, dMMD= currently depressed people with MDD, rMDD= MDD patients in full remission, IGD = internet gaming disorder, SOA = Stimulus onset asynchrony, SCR= skin conductance response

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