# Weber's Law in Feelings Does Not Support James's Theory of Emotions: Commentary on Berkovich and Meiran (2023, 2024)

Ardi Roelofs

Radboud University, Nijmegen, The Netherlands

Emotion, in press

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Ardi Roelofs: Conceptualization, Investigation, Writing - original draft, Writing - review & editing, Visualization.

## Author Note

Correspondence concerning this article should be addressed to Ardi Roelofs, Radboud University, Donders Institute for Brain, Cognition and Behaviour, Centre for Cognition, Thomas van Aquinostraat 4, 6525 GD Nijmegen, The Netherlands. E-mail address: Ardi.Roelofs@donders.ru.nl

**Abstract**

Using an evidence accumulation model of feeling generation to analyze manual responses, Berkovich and Meiran (2023, 2024) observed that feelings of pleasure and displeasure evoked by stimuli follow Weber's law (Weber, 1834, 1846). They regarded this finding as strong support, and perhaps the strongest yet, for James's (1884) theory of emotions, according to which emotions are sensory experiences of bodily changes. Here, I argue that Weber's law cannot, strictly speaking, support James's sensory theory, simply because he excluded feelings of pleasure and displeasure from his theory. James (1894) made this particularly clear in response to Lehmann (1892), who observed that the bodily change (i.e., change in heartbeat and respiration) evoked by stimuli developed after the feeling of pleasure or displeasure was reported, and that therefore the experience of the change could not be the feeling. In modern physiological studies, central indicators of pleasure and displeasure have also been found to precede peripheral bodily changes. Furthermore, the primary interoceptive and proprioceptive brain areas were not found to be activated during pleasure and displeasure, compared to a neutral state. So even if we were to extend James's theory to feelings of pleasure and displeasure, Berkovich and Meiran's findings, in the absence of physiological evidence to the contrary, would not support the theory.

*Keywords*: emotions; feelings; James; Lehmann; Weber's law

Weber's psychophysical law, discovered nearly two centuries ago, states that the just noticeable difference in sensation between two stimuli (e.g., weights) is proportional to their physical strength (Weber, 1834, 1846). This means that as the strength of the stimuli increases, a greater difference in strength is needed to distinguish the stimuli in sensory experience. The discovery of this law was of enormous importance for the historical development of experimental psychology (e.g., Roelofs, 2024). Fechner (1860) and Wundt (1874) hypothesized that Weber's law also applies to pleasure and displeasure, but provided no empirical evidence for this. In a literature review, Lehmann (1914) discussed whether the law applies to the feeling of pleasure evoked by stimuli. He wrote that as "the feeling approaches the maximum, it generally grows much more slowly than near the intensity threshold"[1] (p. 188), the latter referring to the minimum. However, Lehmann considered it impossible to determine whether feelings exactly follow Weber's law.

Recently, Berkovich and Meiran (2023, 2024) observed that feelings of pleasure and displeasure evoked by stimuli obey Weber's law. Their participants looked at standardized feeling-evoking pictures and had to indicate whether each picture made them feel pleasant or unpleasant by pressing one of two buttons. Reaction times were analyzed using an evidence-accumulation model of feeling generation developed by Givon et al. (2020). This model provided a ratio scale for the affective intensity of the stimuli. Berkovich and Meiran's results showed that as the affective intensity of the stimuli increased, the standard deviation of the drift rate of the evidence accumulation also increased. According to Berkovich and Meiran in their 2023 article, their research shows "for the first time that pleasantness feelings follow

[1] All translations of the original German texts in this article are by the author. The source texts are available through the Open Science Framework (Roelofs, 2025a) or from the author.

Weber's law, a result that provides strong support, possibly the strongest thus far, to James' (1884) perceptual theory" (p. 1222). James argued that emotions "are nothing but" (p. 188) sensory experiences of bodily changes, rather than that emotions cause bodily changes (e.g., Wundt, 1863, 1874, 1896). In their 2024 article, Berkovich and Meiran reported that unpleasant feelings also follow Weber's law.

The aim of this article is to show that Weber's law in pleasant and unpleasant feelings does not support James's theory of emotions, simply because James (1884) excluded these primary feelings from his theory. James (1894) made this particularly clear in response to Lehmann (1892), who found that the bodily change evoked by stimuli (i.e., change in heartbeat and respiration) developed after the feeling was reported, and therefore the sensory experience of the change could not be the feeling. According to James, Lehmann's findings do not contradict his theory because it does not apply to feelings of pleasure and displeasure. For the same reason, Berkovich and Meiran's (2023, 2024) findings do not support James's theory. Given that James insisted on excluding pleasure and displeasure from his theory, and that this has often been overlooked since (e.g., Craig, 2015), as it was even in James's time (e.g., Lehmann, 1899a, 1914), it is worth reemphasizing this point.

Below, I indicate what James considered the scope of his theory, briefly describe Lehmann's findings, and James's response. Lehmann (1914) argued that stimulus evaluation evokes an unconscious, central affective state that arises as a feeling in consciousness and leads to a bodily change, as Rolls (2018, 2023) and others in the modern era have argued, rather than the bodily change causing the conscious feeling (James, 1884) or vice versa (Wundt, 1863, 1896). Although the central state can simultaneously evoke a conscious feeling and bodily change, the latter develops more slowly (see Roelofs, 2025b, for

discussion). The term 'state' is used here in a general sense and does not imply fixed, discrete patterns. From this perspective, the work of Berkovich and Meiran shows that the emergence of the central state in consciousness, based on accumulated evidence from sources other than sensory processing of bodily changes, follows Weber's law. Lehmann's view is consistent with modern evidence that feelings are based on a process of appraisal in which the stimulus is evaluated using evidence obtained from the sensory, perceptual, or cognitive processing of the stimulus (e.g., Frijda, 2007; Moors et al., 2013; Scherer, 2001). Appraisal dimensions relate to relevance, including novelty and intrinsic pleasantness, implications, coping potential, and normative significance (e.g., Delplanque et al., 2009). Berkovich and Meiran's task focused on one specific appraisal dimension: the intrinsic pleasantness or unpleasantness of the pictures. The central states responsible for intrinsic pleasantness or unpleasantness have been found to arise in the brain on a time scale of a few hundred milliseconds (e.g., Grandjean & Scherer, 2008; Kawasaki et al., 2001). This is not consistent with a process in which the stimulus first generates a bodily change, which has been found to occur on a time scale of several seconds, and then the sensory processing of the peripheral change generates the intrinsic pleasantness or unpleasantness in the brain.

## James's Sensory Theory

In 1884, James published an article in the journal *Mind* advocating his sensory theory of emotion. He began with a statement about the scope of the theory, followed by its central principle:

> I should say first of all that the only emotions I propose expressly to consider here are those that have a distinct bodily expression. That there are feelings of pleasure

> and displeasure … having no obvious bodily expression for their consequence, would, I suppose, be held true by most readers. ... The case of these feelings we will at present leave entirely aside, and confine our attention to the more complicated cases in which a wave of bodily disturbance of some kind accompanies the perception of the interesting sights or sounds, or the passage of the exciting train of ideas. Surprise, curiosity, rapture, fear, anger, lust, greed, and the like, become then the names of the mental states with which the person is possessed. (p. 189)

> Our natural way of thinking about these standard emotions is that the mental perception of some fact excites the mental affection called the emotion, and that this latter state of mind gives rise to the bodily expression. My thesis on the contrary is that *the bodily changes follow directly the PERCEPTION of the exciting fact, and that our feeling of the same changes as they occur IS the emotion*. (pp. 189–190)

James (1884) made it clear that he considered the experience of the *totality* of bodily changes to be the emotion. He stated:

> The bladder and bowels, the glands of the mouth, throat, and skin, and the liver, are known to be affected gravely in certain severe emotions, and are unquestionably affected transiently when the emotions are of a lighter sort. That the heart-beats and the rhythm of breathing play a leading part in all emotions whatsoever, is a matter too notorious for proof. (p. 192)

> And the various permutations and combinations of which these organic activities are susceptible, make it abstractly possible that no shade of emotion, however slight, should be without a bodily reverberation as unique, when taken in its totality, as is the mental mood itself. The immense number of parts modified in each emotion is what makes it so difficult for us to reproduce in cold blood the total and integral expression of any one of them. (p. 192)

After the 1884 publication, James discovered that the Danish physician Carl Lange had proposed a theory in 1885 in which bodily changes in emotions also play a crucial role (Lange, 1885). Because James's and Lange's views shared the central role of bodily changes, Dewey (1894) coined the term "the James-Lange theory" for their views (a misnomer, as I argued in Roelofs, 2025c). It also became known as the *peripheral* theory of emotion, while the views of Lehmann, Wundt, and others are known as the *central* theory. The first experimental tests were carried out by Lange's compatriot Alfred Lehmann, who, like Lange, was affiliated with the University of Copenhagen.

## Lehmann's Psychophysiological Experiments

Lehmann (1892, 1899a) reported in two books on his systematic investigations of human feelings and emotions, using a kymograph that simultaneously recorded changes in heartbeat and respiration as waveforms on carbon-black paper. The cylinder of the kymograph rotated automatically under the force of a weight. The desired rotation speed could be set, for example one revolution every two minutes, so that information about the timing of the bodily changes was available. A pneumograph around the chest of the participant measured volume changes during respiration and a plethysmograph registered volume changes in the forearm to record the pulse, which reflected the heartbeat. By pressing a rubber bulb, which created a vertical mark on the carbon-black paper, the experimenter could indicate when the stimulus was presented and the participant could indicate when the elicited feeling or emotion occurred.

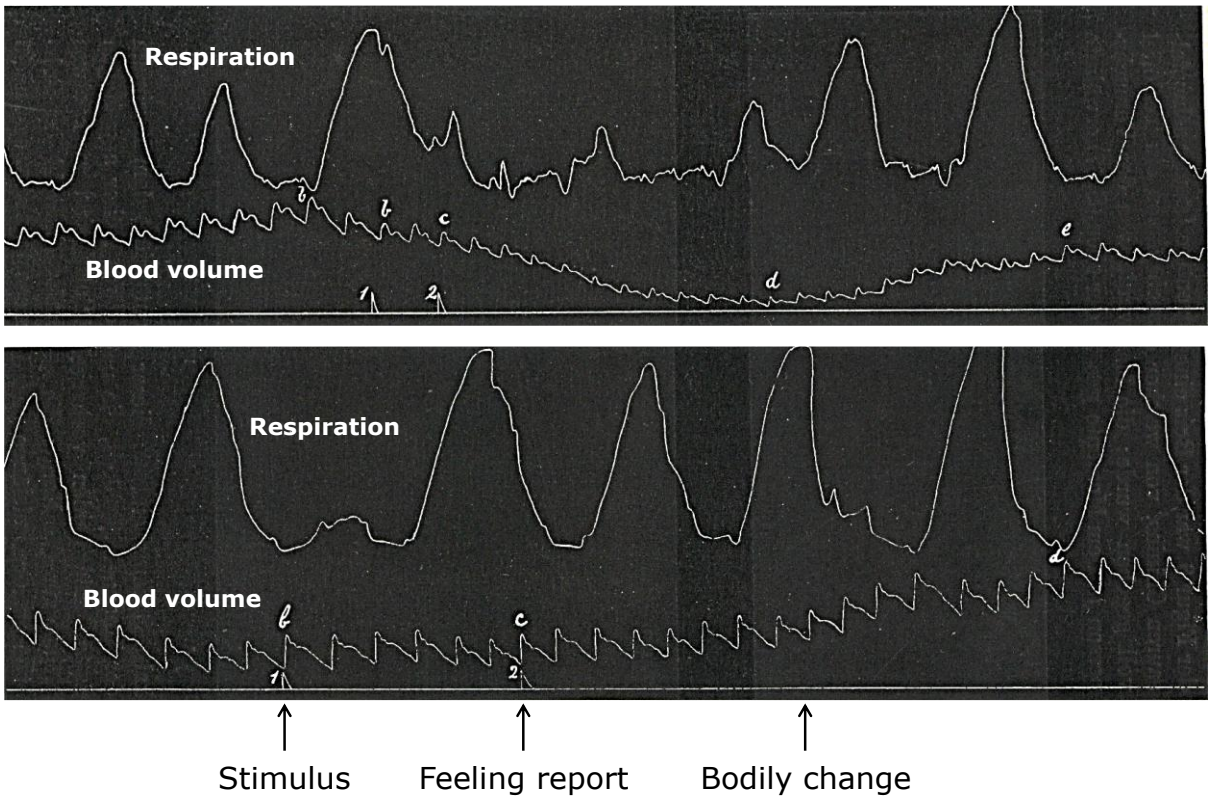
In the experiments, participants were presented with stimuli that elicited simple feelings or emotions, such as a spoon containing a sweet or bitter substance that elicited

pleasant or unpleasant feelings, or a frighteningly loud noise or announcement that elicited fear, and so on. Lehmann used taste, smell, touch, temperature, pain, auditory, and visual stimuli. Regardless of modality, the stimuli produced characteristic changes in respiration and blood volume, including the pulse.

Figure 1 illustrates some of the key observations about pleasant and unpleasant feelings. The graphs show the moments when the experimenter presented a bitter stimulus (top graph) or sweet stimulus (bottom graph), marked 1 on the bottom line, and the participant reported the pleasant or unpleasant feeling, marked 2. In each graph, the upper trace from the pneumograph indicates the change in respiration, and the lower trace from the plethysmograph indicates the change in blood volume in the forearm, including the pulse. The feeling arose more slowly with the pleasant stimulus (in about five seconds) than with the unpleasant stimulus (within about one and a half seconds). In both pleasure and displeasure, the bodily response developed *after* the feeling was reported (e.g., blood volume for the unpleasant stimulus was lowest about eight seconds after the feeling report) and therefore could not be the cause of the feeling.

**Figure 1**

*Recording of the Physiological Change for Displeasure (Bitter Stimulus, Top Graph) and Pleasure (Sweet Stimulus, Bottom Graph). Each Graph Shows Respiration (Upper Trace) and Blood Volume, Including the Pulse (Lower Trace). The Graphs Are from Lehmann's (1899b) Folio-Sized Atlas, Reprinted as Regular Figures in Lehmann (1914)*




Lehmann (1914) reviewed the findings of other laboratories published after his studies. These, too, showed that bodily changes occurred after the feeling. Modern studies confirmed these early findings. For example, an electroencephalographic study found that oscillatory brain activity indicating the conscious, subjective feeling evoked by pictures occurred approximately 800 milliseconds before the overt manual response signaling the feeling, which had an average response latency of two seconds (Dan Glauser & Scherer, 2008). Berkovich and Meiran (2023) found a mean reaction time for the manual response of

1391 milliseconds. The central state responsible for the feeling occurred before the manual response and even longer before the bodily change, which occurred a few seconds later. For example, Delplanque et al. (2009) observed a difference in heart rate between pleasant and unpleasant odors in a time interval of five to eight seconds after stimulus presentation. In contrast, when analyzing global field power in an electroencephalographic study, Grandjean and Scherer (2008) observed a difference between pleasant and unpleasant pictures compared to neutral pictures already between 50 and 200 milliseconds after the onset of the stimulus. Reflections of pleasure and displeasure are typically observed within half a second in event-related brain potentials (for reviews, see Hajcak et al., 2010; Schupp et al., 2006). Kawasaki et al. (2001) recorded the responses of individual neurons to pleasant and unpleasant pictures in human ventral prefrontal cortex during awake neurosurgery. They observed a difference in neuronal responses between 120 and 170 milliseconds after the onset of the pictures.

The primary cortical areas for interoception (i.e., sensing the states of organs within the body) and proprioception (i.e., sensing skeletal-muscular states) in the human brain are the dorsal posterior insula and the somatosensory cortex (e.g., Craig, 2015; Damasio & Carvalho, 2013; Feldman et al., 2024). If pleasure and displeasure are based on interoceptive and proprioceptive information, these areas should be active in response to affective stimuli. Meta-analyses of neuroimaging studies have examined which areas are activated by pleasant or unpleasant stimuli compared to neutral stimuli, using pictures (Mansueto et al., 2025: 152 studies, 5,691 participants) or a broader range of stimuli including sounds, odors, and so on (Kühn & Gallinat, 2012: 39 studies, 635 participants; Lindquist et al., 2016: 397 studies, 6,827 participants). However, the somatosensory cortex and the dorsal posterior insula (MNI y-coordinate between −30 and −10, Craig, p. 183) were not among the activated areas.

Mansueto et al. and Kühn and Gallinat found no activation of the somatosensory and insular cortex at all, while Lindquist et al. found activation of the anterior insula, not the dorsal posterior insula, which contains the primary interoceptive cortex. Unlike the rest of the insula, the dorsal posterior insula has granular layers (e.g., Quabs et al., 2022), which is characteristic of primary sensory areas, such as the somatosensory and primary visual and auditory cortices (e.g., Feldman et al., 2024). I mention the number of studies and participants to demonstrate that the meta-analyses were not underpowered. Thus, there is no evidence from neuroimaging that the pleasantness or unpleasantness of pictures and other stimuli arises from interoceptive or proprioceptive processing.

In a meta-analysis of neuroimaging studies of emotions such as anger, disgust, fear, happiness, and sadness, the primary interoceptive and proprioceptive areas were also not found to be activated (Kober et al., 2008: 162 studies, 1,993 participants). The anterior and middle insula were among the activated areas, but not the dorsal posterior insula and the somatosensory cortex. It may be objected that meta-analyses report coordinates of peak activations and that the peak does not reflect the spatial extent of the activation in the insula. However, if interoception is central to feelings and emotions evoked by stimuli, as peripheral theories claim, then a peak activation should have been found in the dorsal posterior insula, but this was not the case. The lack of activation of the primary interoceptive and proprioceptive cortical areas therefore challenges the idea that feelings and emotions are simply the experience of bodily changes through interoception and proprioception. It is important to note that in a meta-analysis of studies on heartbeat interoception by Schulz (2016: 9 studies, 262 participants), outside the domain of feelings and emotions, a peak activation was found in the dorsal posterior insula. This confirmed previous evidence that this

area underlies interoception (Craig, 2015), but, given the absence of activation in the affective meta-analyses, apparently not stimulus-induced feelings and emotions.

In conclusion, the pleasantness and unpleasantness of stimuli were found to be reflected in brain activity on a time scale of several hundred milliseconds, while the bodily change occurred much later, on a time scale of several seconds. Sensing the bodily change could not be the cause of the brain activity found to underlie pleasure and displeasure. Moreover, the brain areas primarily responsible for sensory processing of bodily states through interoception or proprioception were not found to be activated by affective pictures and other stimuli.

It is important to note that Lehmann did not deny that experiencing a bodily state, such as hunger, satiety, or fatigue, can elicit feelings of displeasure or pleasure, just as the sensation of external stimuli (e.g., taste, smell, and so on) can. Furthermore, Lehmann (1899a, 1914) and Wundt (1896) attributed a role to the experience of bodily changes during emotions, by assuming that these experiences can amplify the emotion, which Wundt called *Affectverstärkung* (p. 208). This latter aspect, however, concerns late feedback, not the initial generation of emotions. In discussing his finding that feelings precede the bodily change, Lehmann (1899a) stated:

> This does not, however, eliminate the importance of bodily reactions for conscious life. Even if they are not primary and decisive for feelings, they can nevertheless, as secondary phenomena, exert a significant influence on the overall state of consciousness. (p. 196)

This view is consistent with modern evidence showing correlations between individual differences in interoceptive ability and affective experiences, measured by self-

report or behavior, and between measures of bodily change (e.g., heart rate), brain activation, and affective experiences (e.g., Feldman et al., 2024). However, the correlations say nothing about cause and effect (i.e., whether central states cause the bodily changes or vice versa) and may relate to late feedback.

## James's Response to Lehmann

In response to Lehmann (1892), James (1894) argued that the psychophysiological findings do not refute his theory, contrary to what Lehmann had claimed. James emphasized that his theory concerns emotions such as fear and anger (i.e., "*emotional seizure* or *Affect*"), not the feeling of pleasure and displeasure ("primary feeling"), as he had already made clear at the beginning of his 1884 article. James wrote:

> Dr. Lehmann enters into an elaborate argument to prove (as he alleges, against Lange and me) that primary feeling, as a possible accompaniment of any sensation whatever, must be admitted to exist. ... Such objections are a complete *ignoratio elenchi* [irrelevant conclusion, missing the point], addressed to some imaginary theory with which my own, as I myself understand it, has nothing whatever to do, all that I have ever maintained being the dependence on incoming currents of the *emotional seizure* or *Affect*. (pp. 524–525)

In reviewing the literature on feelings and emotions, Lehmann (1914) returned to this issue. He recognized that if this was a limitation on the scope of James's theory, his findings on pleasure and displeasure did not indeed refute the theory. After quoting the above passage from James, he wrote:

> These words at least can hardly be misunderstood, and it is therefore quite incomprehensible why James should continue to be considered the originator of the

> peripheral theory of feelings. Lange, on the other hand, takes a different position. One would hardly be able to find anything in his book that directly targets the elementary feelings; but I know from a personal conversation with him about this question, which lasted several hours, that he saw his theory as valid for all affective phenomena. (p. 55)

Lehmann (1899a) had excused himself by stating that he was not the only person who had misunderstood the scope of James's theory. However, not everyone misinterpreted James. Referring to the limitation of the scope of James's theory, Sherrington (1900a) stated that James "urges his theory as one which is completely competent only for the "coarser" emotions, among which he instances "fear, anger, love, grief"" (p. 392).

## Relevance for Berkovich and Meiran's Claim

The limitation that James (1884, 1894) made regarding the scope of his theory is relevant not only to Lehmann (1892), but also to Berkovich and Meiran (2023, 2024). If James's theory does not apply to feelings of pleasure and displeasure, then their finding that Weber's law applies to stimulus-induced pleasure and displeasure cannot support James's theory. It is important to note that this does not detract from the importance of their findings. The question of whether feelings follow Weber's law, which Lehmann (1914) thought impossible to determine a century ago, is answered by the research of Berkovich and Meiran.

Berkovich and Meiran could argue that their supposed support for James's theory pertains only to the claim about sensation, without the assumption that the sensation involves bodily changes. However, such a limitation would ignore the essence of James's position. Emotions clearly cannot be sensations of stimulus properties, as color or sound sensations are. Instead, James argued that emotions are sensations of bodily states. In the literature, the

term "James's theory of emotions" refers to the view that emotions are bodily sensations (e.g., *APA Dictionary of Psychology*, VandenBos, 2015). In the (German) literature of James's time, the sensations of the bodily state were called *Gemeingefühl* (e.g., Weber, 1846; Wundt, 1896), which included both interoception and proprioception (for reviews, see Craig, 2015; Feldman et al., 2024; Sherrington, 1900b). Central to interoception are the sensations of changes in heartbeat and breathing, which were studied by Lehmann.

For Berkovich and Meiran's findings to be relevant to James's theory, it would have to apply to feelings of pleasure and displeasure, which James (1884, 1894) argued is not the case. But even if this limitation were ignored and pleasure and displeasure were included, Berkovich and Meiran's findings still do not support James's theory. This is because Lehmann (1892, 1899a) and others after him observed that changes in heartbeat and respiration followed the feeling of pleasure or displeasure, and so the sensation of the changes could not be the feeling. Berkovich and Meiran examined manual responses to pictures and did not measure bodily changes, such as changes in heartbeat and breathing. Thus, their experiments provided no evidence to challenge the finding that central indicators of pleasure and displeasure preceded bodily changes, as observed by Lehmann and confirmed in modern research. Furthermore, the primary interoceptive and proprioceptive areas of the brain were not found to be activated, which also contradicts James's claim that interoception and proprioception are essential.

Of course, James's theory could be modified to better align it with the empirical findings. For example, James (1884) considered the possibility that emotions arise from motor commands to the heart, lungs, and other organs, producing the bodily changes corresponding to emotions, but he rejected this possibility. He wrote:

> Of course the physiological question arises, how are the changes felt?—*after* they are produced, by the sensory nerves of the organs bringing back to the brain a report of the modifications that have occurred? or *before* they are produced, by our being conscious of the outgoing nerve-currents starting on their way downward towards the parts they are to excite? I believe all the evidence we have to be in favour of the former alternative. (p. 193)

If, contrary to James's claim, emotions arise from motor commands, they can precede actual bodily changes. However, this would undermine the core of James's theory, which considers actual bodily changes essential. James (1884) stated:

> Without the bodily states following on the perception, the latter would be purely cognitive in form, pale, colourless, destitute of emotional warmth. We might then see the bear, and judge it best to run, receive the insult and deem it right to strike, but we could not actually *feel* afraid or angry. (p. 190)

In summary, my argument against Berkovich and Meiran's claim that their findings on pleasure and displeasure strongly support James's theory of emotions is twofold. First, James excluded feelings of pleasure and displeasure from his theory. Second, even if the theory is extended to encompass these feelings, it is challenged by Lehmann's observation, also made in modern studies, that central indicators of pleasure and displeasure preceded bodily changes. Furthermore, it was found that the primary interoceptive and proprioceptive cortical areas were not activated in response to affective stimuli. Berkovich and Meiran's experiments provided no evidence to question these findings.

Berkovich and Meiran referred several times to Laird and Lacasse (2014). In defending James's theory of emotion, these authors recognized that the slowness of change in heartbeat and respiration provides a powerful argument "against the possibility that visceral

responses alone produce emotional experience. But of course, James's full theory would include facial expressions and expressive behaviors which are rapid and can help provide distinctive, differentiated feedback" (p. 28). Indeed, facial expressions are not only associated with emotions, but also accompany pleasant and unpleasant feelings, where muscle activity occurs quickly. For example, Delplanque et al. (2009) found that the pleasantness of odors was observed in the recording of heart rate only five to eight seconds after odor presentation, but already after half a second in the electromyographic activity of the facial muscles. Wu et al. (2012) observed a similar onset between 0.5–1.0 seconds for facial electromyographic activity in response to pleasant and unpleasant pictures. Of course, the facial expression must first develop and then be internally observed and interpreted, which takes time, but presumably less than sensing visceral changes. This could be said to save James's theory if it applied to feelings of pleasure and displeasure, which James himself said it does not. But even if the application of the theory is extended to pleasure and displeasure, rapid facial muscle activity alone will not help the theory. For James it is the *totality* of bodily changes that matters (i.e., visceral changes, facial expression, and other bodily changes), so isolated facial expressions are not enough. Furthermore, as discussed earlier, meta-analyses of the neuroimaging literature found that the primary cortical area for proprioception (i.e., the somatosensory cortex), which includes the sensing of facial muscles, was not activated in response to affective stimuli. This challenges the attempt to rescue James's theory by referring to facial expressions.

A question left unanswered by a peripheral theory like James's is why, after the perception of the object or event (say, a bear or insult), a bodily change must first be generated and then sensorially processed from the periphery, and why a central state

responsible for the feeling and emotion cannot be generated directly, followed by the bodily change. Also in the latter case, a bodily change occurs, which can deepen the feeling or emotion, but this concerns an effect on something that already exists. A peripheral theory, on the other hand, must explain precisely how the feeling and emotion arise from the bodily change, "a notoriously difficult procedure" (Rolls, 2023, p. 1244).

My article focuses on James's theory and the question of whether Berkovich and Meiran's (2023, 2024) findings support it, as they claim. Several theories in the literature offer perspectives on the role of bodily changes in affective experience that differ in some way from James's theory (e.g., Barrett, 2017; Craig, 2015; Damasio, 2021). It is beyond the scope of this article to discuss these theories in detail, but a brief comment is possible.

Craig (2015) maintained that "the neural substrates which substantialize bodily feelings also provide the basis for our subjective awareness of emotional and social feelings, like pleasure, anxiety, trust, and anger. ... they support the James-Lange theory of emotion and its modern refinements" (p. xiii). Damasio (2021) argued that "*everything we feel corresponds to states of our interior* ... how either parts or the whole of our own organism are faring, moment by moment" (p. 74). It is important to emphasize again that a central theory does not deny that experiencing a bodily state can evoke feelings of pleasure or displeasure, just as the sensing of external stimuli can. However, pleasure and displeasure are considered different from interoception and proprioception. For example, fatigue can feel pleasant after a workout, but unpleasant when there is still a lot of work to be done. Similarly, eating can feel pleasant when one is hungry, but unpleasant when one has already eaten too much. Moreover, to the extent that feelings and emotions in these other theories (Craig's, Damasio's) depend on interoception and proprioception for their origination after the

perception of an object or event (say, a bear or insult), the theories are called into question by the findings of Lehmann (1892, 1899a) and modern confirmations of his conclusion. Barrett (2017) argued, "Simple pleasant and unpleasant feelings come from an ongoing process inside you called *interoception*" (p. 56). But she also argued that "the general pleasant, unpleasant, aroused, and quiescent sensations of affect *are not really coming from inside your body*. They are driven by simulations in your interoceptive network. … Affect primarily comes from prediction" (p. 78). This view differs from James's and is consistent with the evidence of Lehmann and others regarding the timing of feelings and actual bodily changes. However, Barrett's view is challenged by the absence of activation in the primary interoceptive cortex, the dorsal posterior insula, in meta-analyses of neuroimaging studies (Kober et al., 2008; Kühn & Gallinat, 2012; Lindquist et al., 2016; Mansueto et al., 2025). As noted, Mansueto et al. and Kühn and Gallinat found no activation of the insular cortex whatsoever, while Kober et al. and Lindquist et al. found activation of the anterior and middle insula, not the dorsal posterior insula, the relevant area here (e.g., Wilson-Mendenhall et al., 2018). For the same reason, the views of Craig (2015) and Damasio (2021) are challenged.

I want to emphasize that I recognize that peripheral afferents can influence or cause feelings and emotions, but that is not the issue here. The question addressed in my article is whether a stimulus must first elicit a bodily response, the experience of which is the emotion (James) or feeling, or whether the initial response is a central response, giving rise to the feeling or emotion, and followed by a bodily change (Lehmann). Berkovich and Meiran assumed the former.

## Summary and Conclusion

Berkovich and Meiran's evidence that Weber's law applies to pleasant and unpleasant feelings cannot support James's theory of emotions simply because he excluded feelings of pleasure and displeasure from his theory. James emphasized this limitation in scope in response to the work of Lehmann, who reported that the bodily change evoked by stimuli developed after the feeling of pleasure or displeasure was reported, and therefore the peripheral change could not be the cause of the feeling. In modern physiological studies, central indicators of pleasure and displeasure have also been found to precede peripheral bodily changes. Furthermore, it was found that the primary interoceptive and proprioceptive areas of the cortex were not activated in response to affective stimuli. Thus, even if we were to extend James's theory to feelings of pleasure and displeasure, Berkovich and Meiran's findings, in the absence of physiological evidence to the contrary, would not support the theory.

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