1. Introduction

Emotions pervade our everyday life. Imagine a regular workday. In the morning, we get *angered* by the sound of the alarm clock, *enjoy* our first coffee, fear that we might be late for work, and so on. But what is anger, joy, or fear? According to one influential view, emotions are constituted by changes in one’s own body, and the experience of emotion consists on feeling those changes as they occur.\(^1\) Understood this way, anger is constituted by bodily changes such as a rise in bodily temperature, fear is constituted by bodily changes such as shivering, and so on. This view dates back to the work of William James (1884) and Carl Lange (1922), and it has been revamped in the work of contemporary authors in both philosophy (Prinz 2004) and psychology (Damasio 1994). Because of their emphasis on the role of the body, these accounts are known as Somatic or Embodied theories of emotion.

Embodied theories of emotion have some intuitive attractiveness. Ordinary language expressions and metaphors for emotions suggest that bodily changes feature centrally in our emotional experiences. For example, when we are angry, we say that our “blood is boiling”. And when we are afraid, we feel “the chills”. Furthermore, there is ample evidence showing that emotional experiences are accompanied by a range of potentially felt changes in cardiovascular, respiratory, and electrodermal activity (see Kreibig, 2010 for a review). However, a mere association between emotional experiences and felt bodily changes do not prove Embodied theories right. The bodily changes associated with emotional experiences

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\(^1\) Although some Embodied accounts identify emotions with feelings, most Embodied accounts differentiate between emotion, which is constituted by bodily changes, and the experience of emotion, which consist on feeling those bodily changes. This way, they can account for the existence of unconscious emotions (Prinz, 2004).
could be consequences of the (otherwise disembodied) emotions. For example, some theories (see §2) claim that emotions are judgments, which in turn cause bodily changes. Thus, the crucial question is whether bodily changes are essential to emotion.

The phenomenology of emotion, what is like to be in an emotional state, is supposed to show that bodily changes are not mere by-products but rather essential ingredients of emotion. Consider the following thought experiment. Imagine having an emotion (e.g. fear) and subtract from the experience of it all the feelings of bodily changes that it involves (e.g. accelerated heartbeat, sweaty palms, shivering, …). What is left? According to William James, who first presented this thought experiment, the outcome is clear. After subtracting the feelings of bodily changes, “we have nothing left behind” and “most people, when asked, say that their introspection verifies this statement” (James, 1884, p. 193). Without feelings of bodily changes, the emotional experience is not merely impoverished, but is not emotional at all. Thus, bodily changes are essential to emotion. This is known as the Subtraction Argument.

Contemporary neo-Jamesian authors still use the Subtraction argument to defend their claims. We can find references to the Subtraction Argument in the work of Julien Deonna and Fabrice Teroni: “Emotions are psychological episodes whose nature must be understood in terms of the way the body feels. This is the conclusion James (1890/1950) draws from his famous subtraction argument” (Deonna and Teroni 2017), Rebekka Hufendiek: “James’s central argument for this [emotions’ embodiment] is of a phenomenological character: if you imagine a strong emotion and try to subtract the feeling of all involved bodily symptoms, nothing remains” (Hufendiek 2016), or Jesse Prinz: “A number of arguments [for emotions’ embodiment] can be discerned in the pages of James and Lange. The most famous is the Subtraction Argument.” (Prinz, 2004, p. 55-56).
Authors who defend Disembodied accounts of emotion, however, have made opposite claims regarding the role of bodily changes in emotional experiences. Martha Nussbaum, for example, claims that “There usually will be bodily sensations and changes of many sorts involved in grieving; but if we discovered that my blood pressure was quite low during this whole episode, or that my pulse rate never got above sixty, we would not, I think, have the slightest reason to conclude that I was not really grieving.” (Nussbaum, 2001, pp. 57-58), and Peter Goldie states that “Intuitively, it might seem rather obvious that bodily feelings which are characteristic of an emotional experience are not necessary for it.” (Goldie, 2000, p. 52). As James does, these authors appeal to our intuitions regarding the phenomenology of emotion. However, they draw the opposite conclusion. Namely, that bodily changes are not essential to emotion.

In order to advance the debate between Embodied and Disembodied theories of emotion, I conducted a series of experimental-philosophical studies testing people’s intuitions regarding the Subtraction Argument. In the next section, I will introduce the debate between embodied and disembodied accounts of emotion. Afterwards, I will present the Subtraction Argument. The results of two new studies will show that, contrary to James’ claims, most people consider that their hypothetical (Study 1) and actual (Study 2) emotional experiences persist in the absence of bodily feelings. Finally, I will discuss the results in the context of extant studies on cases of impaired interoception and extract implications for emotion theory.

2. Embodied or Disembodied, that is the question

Prototypical emotional experiences involve a variety of elements. Most importantly, emotions seem to have both a cognitive and a bodily element. Consider the following
example. You are sitting at your computer and you receive a new email. The reviews of your latest paper are in. They start by mentioning that your article is not good enough for the journal. Then, they present objections to your main point that you already considered and answered in the manuscript. Finally, they tell you to look at some references that you already know about and are orthogonal to your research question. You find these comments extremely offensive and dismissive. You feel your heart pounding and your blood boiling. You clench your fist and punch the table. You are so angry.

As we see in the case above, experiencing an emotion typically involves some cognitive evaluation of the eliciting situation or event. In anger, for example, we evaluate the situation as offensive or unfair. But not only our mind is running. Our body reacts as well. In anger, our body prepares for retaliation, quickly pumping blood and clenching muscles. Paradigmatic examples of emotion involve both cognitive and bodily components. But which of them is the essence of the emotion? Can we experience emotions without one of these components?\(^2\)

Responses to the questions above separate theories of emotion in two main camps, exemplified in the classic Lazarus-Zajonc debate (Lazarus 1984; Zajonc 1984). Lazarus gives cognition primacy, relegating bodily changes and actions to the status of mere consequences of one’s cognitive evaluation of the situation. Zajonc argues that emotions can occur without any cognitive evaluation, bodily arousal being the central aspect of emotion. Lazarus’ account is an example of Cognitive or Disembodied account of emotion, while Zajonc represents Somatic or Embodied theories. It is important to note that there are many different

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\(^2\) This is what Jesse Prinz calls the Problem of Parts (Prinz, 2004), the problem of determining which components are essential and which are not. Accounts that identify emotion with a combination of cognitive and bodily elements face a different problem, the Problem of Plenty, which consist of explaining how very different elements hang together to create a unitary phenomenon.
theories within each side of the Embodied vs Disembodied divide, each with its particular
nuances. Reviewing all the different positions, however, is beyond the scope of this paper
(for useful reviews, see Deonna and Teroni, 2012; Scarantino and de Sousa, 2018). For our
purposes here, we will classify emotion theories as Embodied or Disembodied theories.

Disembodied theories include theories that identify emotions with judgments of value
(Nussbaum 2001; Solomon 2003), perceptions of value (Tappolet 2016; Rossi and Tappolet
2018), or feelings towards value (Goldie 2000; Mitchell 2018). Most Embodied theories
identify emotions with perceptions of one’s own bodily changes (James 1884; Prinz 2004;
Hufendiek 2016). But some identify emotions with embodied attitudes (Deonna and Teroni
2017). Furthermore, “impure” Embodied theories hold that both bodily changes and
representations of external objects or events are essential to emotion (Barlassina and Newen
2014), or at least to some emotions (Damasio 1994). Despite these differences, however, all
Embodied theories posit that bodily changes (or perceptions thereof) are essential to emotion.
Conversely, all Disembodied theories defend that bodily changes are not essential to emotion.

3. The Subtraction Argument

The claim that bodily changes are essential to emotion creates one of the most important
dives in emotion theory. What are the arguments that support that claim? As we have seen
in §1, the main argument in favor of Embodied theories is William James’ Subtraction Argument:

“I now proceed to urge the vital point of my whole theory, which is this. If we fancy some strong emotion and then try to abstract from our consciousness of it all the feelings of its bodily symptoms, we find we have nothing left behind, no ‘mind-stuff’ out of which the emotion can be constituted, and that a cold and neutral state of intellectual perception is all that remains.” (James, 1884, p. 193).

In order to defend the claim that bodily changes are essential to emotion, William James builds on a thought experiment. In this thought experiment, we are first told to imagine a strong emotional experience. Then, we are asked to subtract from consciousness all the feelings of bodily changes that it involves. The resulting intuition is that, in the absence of felt of bodily changes, the emotion disappears. Thus, as Embodied theories claim, bodily changes are essential to emotion.

The Subtraction Argument is an argument from phenomenology. It builds on our first-person knowledge of what it is like to experience an emotion. However, it does not rely on us

3 In his essay “The emotions”, Carl Lange makes a similar point: “Take away the bodily symptoms from a frightened individual; let his pulse beat calmly, his look be firm, his color normal, his movements quick and sure, his speech strong, his thoughts clear; and what remains of his fear?” (Lange, 1922, p. 66)

4 Other arguments in the Embodied vs Disembodied debate are not directly about whether bodily changes are essential to emotion. Many arguments are concerned with the explanatory power of each view. For example, it is usually claimed that Embodied theories cannot account for the intentionality of emotions, the fact that emotions are directed towards objects and events in the world (e.g. fear of heights, fear that the market will crash, etc.). Conversely, Disembodied theories are sometimes accused of ignoring the phenomenology of emotion, the fact that emotions feel in certain ways. Note, however, that these challenges do not remain unanswered. For example, Embodied theories have explained the intentionality of emotion by endorsing teleosemantics (Prinz, 2004) or an action-oriented understanding of bodily changes (Deonna & Teroni, 2017; Hufendieck, 2015). And Disembodied theories have explained the phenomenology of emotion in terms of cognitive phenomenology (Nussbaum, 2001) or perceptual phenomenology (Tappolet, 2016).
enacting an actual emotional experience. The task that James’ proposes “is the purely speculative one of subtracting certain elements of feeling from an emotional state supposed to exist in its fullness, and saying what the residual elements are” (James, 1884, p. 193). The Subtraction Argument is thus not so different from other philosophical thought experiments such as, e.g. the Trolley dilemma (Foot 1967).\(^5\) We are presented with a hypothetical case, and we are told to make a judgment about the relevant concept, e.g. moral permissibility or emotion. The same way that Phillipa Foot claims that the intuitive response to the Trolley dilemma is that we should divert the runaway trolley to the tracks were it will kill fewer people, William James claims that the intuitive response to his thought experiment is that the emotional experience disappears in the absence of bodily feelings. These responses are in turn used as premises to argue for certain conclusion (Brun 2017), e.g. that the number of lives matter morally, or that bodily changes are essential to emotion.

Extensive work in moral psychology has shown that most people share Foot’s intuition regarding the Trolley dilemma (Waldmann et al. 2012).\(^6\) But do people share James’ (and neo-Jamesians) intuition regarding the Subtraction Argument? In the next section, I will present the results of an experimental-philosophical study designed to answer this question.

4. Study 1

In order to test whether people share James’ intuitions regarding the Subtraction Argument, a simple task was designed. In this task, participants are asked to imagine a full emotional

\(^5\) “Be supposed that he is the driver of a runaway tram which he can only steer from one narrow track on to another; five men are working on one track and one man on the other; anyone on the track he enters is bound to be killed.” (Foot, 1967, p. 2)

\(^6\) But variations on Foot’s “Switch” version of the dilemma alter the pattern of responses.
experience and then subtract the bodily feelings that it involves. I used the specific examples of subtraction that James presents in his 1884 paper. In this paper, James shows how the subtraction would work for three different emotions: grief (sadness), rage (anger), and fear. The fear case, for example, is as follows:

What kind of an emotion of fear would be left, if the feeling neither of quickened heart-beats nor of shallow breathing, neither of trembling lips nor of weakened limbs, neither of goose-flesh nor of visceral stirrings, were present, it is quite impossible to think. (James, 1884, pp. 193-194)

Our materials in this Study were modeled after this passage and the corresponding ones for sadness and anger (see footnote 8). Sampling, design and analysis were pre-registered.

4.1. Method

In the following, I will describe the procedure for the Fear case (see also Table 1). The same procedure, but different wordings, were used for sadness and anger. Two steps were used to make participants imagine a fear experience. First, participants were asked to ‘Please think of a really dangerous situation and write it in the box below’. Then, they were told to ‘Now imagine yourself facing that situation’ and answered the question ‘Would you be afraid?’ on a scale from 1 (‘definitely not’) to 4 (‘definitely yes’) (from now on, I will refer to responses to this question as ‘pre-subtraction emotion ratings’). As it is required that participants first imagine a full emotional experience, participants who answered 1 (‘definitely not’) or 2

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7 218 participants were recruited through Amazon Mechanical Turk and completed the survey for a monetary payment. They were randomly assigned to one of our three cases (fear, anger, sadness). 21 participants did not complete the survey and 8 participants did not pass the control question (see below). Following the inclusion criteria established in the preregistration form, these participants were excluded. The final sample consisted of 189 participants (103 male, 85 female, 1 other, \( M_{age} = 36.28, \ SD = 12.39, \) age range 20-84). Post-hoc power analyses using G*Power showed that we had 99% power to detect an effect of \( d = .5 \).
(‘probably not’) were excluded from the analysis. Afterwards, participants were asked to subtract the bodily feelings from their emotional experience using James’ original wording (‘Now imagine that you don’t feel quickened heart beats nor shallow breathing, neither trembling lips or weakened limbs, neither goose-flesh nor visceral feelings’)\(^8\) and answered the question ‘Would you still consider yourself to be afraid?’ on a scale from 1 (‘definitely not’) to 4 (‘definitely yes’) (from now on, I will refer to responses to this question as ‘post-subtraction emotion ratings’). Finally, participants were asked to justify their responses by writing a response to the question ‘Why would you still (no longer) consider yourself to be afraid?’.

| Preamble | Please think of a really dangerous (sad, offensive) situation and write it in the box below.  
(Open text) |
|----------|---------------------------------------------------------------------------------------------------------------------------------|
| Pre-Subtraction Ratings | Now imagine yourself facing that situation. Would you be afraid (sad, angry)?  
(1 ‘definitely not’ to 4 ‘definitely yes’) |
| Post-Subtraction Ratings | Now imagine that you don’t feel… (James’ original wording for each emotion). Would you still consider yourself to be afraid (sad, angry)’?  
(1 ‘definitely not’ to 4 ‘definitely yes’) |

\(^8\) Wording for the Anger and Sadness cases were “Now imagine that you feel no ebullition in the chest, no flushing of the face, no dilatation of the nostrils, no clenching of the teeth, no impulse to vigorous action” (Anger) and “Now imagine that you don't cry or sob, you don't feel suffocation of the heart nor a pang in the breast bone.” (Sadness) (see James, 1884, p. 194).
Why would you still (no longer) consider yourself to be afraid (sad, angry)?’

(Open text)

Table 1. Procedure for Study 1.

Apart from recording participants’ intuitions regarding James’ thought experiment, individual differences in cognitive reflection and interoceptive awareness were measured. Two scales were used for this: the cognitive reflection test\(^9\) (CRT; Frederick, 2005) and the private body consciousness scale\(^10\) (PBCS; Miller, Murphy, & Buss, 1981).

4.2. Results

Exploratory analyses\(^11\) showed that pre-subtraction emotion ratings (Mean = 3.76, SD = .430) were significantly higher than post-subtraction emotion ratings (Mean = 3.09, SD = .843),

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\(^9\) The CRT consists in three questions. For example: ‘A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much (cents) does the ball cost?’ It is considered that, in order to answer this question correctly, one has to override giving the intuitive response ($0.10). The CRT is thus supposed to measure one’s tendency to engage in cognitive reflection, the tendency to respond, ‘on a second thought’. After the CRT scale, participants were asked to rate their familiarity with its questions on a scale from 1 (not familiar at all) to 5 (extremely familiar).

\(^10\) The PBCS consists in 5 statements (e.g. ‘I am sensitive to internal bodily tensions’). Participants rated how characteristic each statement is of them on a scale from 0 (extremely uncharacteristic) to 4 (extremely characteristic). They are given a final score, ranging from 0 to 20, which indicates their degree of awareness of their own bodily states.

\(^11\) The claim made by James is not that emotion is significantly influenced by the absence of bodily feelings, but that emotion disappears in the absence of bodily feelings. Thus, the main analyses, the ones that featured in the pre-registration, contrast participants’ intuitions regarding whether emotion disappears or not with James’ intuitions on this respect.
However, and most importantly, participants’ responses to the post-subtraction question (Mean = 3.09, SD = .843) were significantly higher than James’ answer of 1 (‘definitely not’), $t(188) = 34.1, p < .001, d = 2.479$. Participants’ responses to this question were also significantly higher than the scale’s midpoint (2.5), $t(188) = 9.6, p < .001, d = .800$ (see Figure 1). The vast majority of participants (77.3%) responded to the post-subtraction question by choosing either ‘probably yes’ or ‘definitely yes’.

Neither CRT scores ($B = -.037, p = .617$) nor PBCS scores ($B = -.080, p = .277$) predicted participants’ responses to the subtraction question. A second analysis introducing familiarity with the CRT as a moderator showed no significant results from the interaction of CRT scores and familiarity on participants’ responses to the subtraction question ($B = -.048, p = .203$).

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12 Non-parametric tests yielded similar results. Wilcoxon signed-rank test showed that pre-subtraction emotion ratings (Median = 4) were significantly higher than post-subtraction emotion ratings (Median = 3), $Z = -8.559, p < .001$.

13 James response to the subtraction question is a clear ‘no’: “We have nothing left behind, no ‘mind-stuff’ out of which the emotion can be constituted” (James, 1884, p193)

14 Non-parametric tests yielded similar results. One-sample Kolmogorov-Smirnov Test showed that post-subtraction emotion ratings did not follow a normal distribution, $D(189) = .230, p < .001$.

15 The internal reliability was good for both the CRT ($= .760$) and the PBCS ($= .755$).
4.3. **Text analyses**

To further strengthen confidence in the results, I conducted text analyses of participants’ responses to the justification question (‘Why would you still (no longer) consider yourself to be afraid (angry, sad)?’). Participants’ justifications were classified by the main author in 8 categories using word-frequency queries. Afterwards, two independent coders were given written descriptions of each category and themselves coded participants’ responses. Cohen’s \( k \) was run to determine if there was agreement between their coding and the author’s coding (McHugh, 2012). There was substantial agreement for most categories, with agreement percentages running from 81.98% (\( k = .54 \)) to 99.10% (\( k = .97 \)).
Most participants provided relevant justifications for their responses. For example, among those participants who would not consider themselves afraid (angry, sad) after the subtraction, 72.09% explicitly mention that physical reactions are necessary for emotion. Furthermore, among participants who would consider themselves to be afraid (angry, sad) after the subtraction, only 8.22% mentioned the possibility of alternative bodily manifestations, and only 6.85% mentioned the possibility of internal manifestations. Table 2 shows the full distribution of responses across categories.

<table>
<thead>
<tr>
<th>Emotion Post-Subtraction</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nodes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Evaluation of the situation</strong></td>
<td>34.25% (50)</td>
<td>2.33% (1)</td>
</tr>
<tr>
<td>e.g. “Would be a situation that could end badly.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Emotion is mental</strong></td>
<td>28.08% (41)</td>
<td>2.33% (1)</td>
</tr>
<tr>
<td>e.g. “[…] absence any physical manifestation or fear, you’re still mentally and psychologically afraid.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physical reaction is not necessary</strong></td>
<td>24.66% (36)</td>
<td>0%</td>
</tr>
<tr>
<td>e.g. “You don’t always show physical signs of anger, sometimes slight anger does not arouse a physical response”</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physical reaction is necessary</strong></td>
<td>0.68% (1)</td>
<td>72.09% (31)</td>
</tr>
<tr>
<td>e.g. “Those are the kind of feelings that you have when you are sad or heartbroken”</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Situation</strong></td>
<td>20.55% (30)</td>
<td>4.65% (2)</td>
</tr>
<tr>
<td>e.g. “The risk is still there, and it will creep on you while you least expect it”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Alternative manifestations 8.22% (12) 0%
e.g. “Those are some people's physical reactions to anger, but not everyone's.”

Internal vs External 6.85% (10) 0%
e.g. “On the inside I would be scared and that's what matters, not what I feel on the outside.”

Other 26.03% (38) 25.58% (11)
e.g. “Yes”

**Table 2.** Percentage (absolute number) of justification responses falling on each category by participants’ answer to the post-subtraction question. Note that the percentages are calculated over the total number of responses, but each response might be coded at several nodes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
<th>Absolute Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative manifestations</td>
<td>8.22%</td>
<td>12</td>
</tr>
<tr>
<td>Internal vs External</td>
<td>6.85%</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>26.03%</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>149.32%</td>
<td>218</td>
</tr>
</tbody>
</table>

4.4. Discussion

In Study 1, most participants (77.3%) considered that they would still be afraid (angry, sad) after subtracting the bodily feelings from an emotional experience. This suggest that James’ intuitions, and those of the authors that have accepted his conclusions, might be biased by their theoretical commitments (see Stich and Machery 2018). Alternatively, pre-theoretical factors might underlie different intuitions regarding the Subtraction Argument. In the present study, two possible candidates were tested: the tendency to engage in cognitive reflection, and the awareness of one’s own bodily states. Our results suggest that participants’ responses
to the subtraction question were independent of individual differences in those two aspects. Finally, the results of the text analyses rule out other alternative explanations for the results. First, the pattern of responses to the justification question suggests that participants had no problems understanding the task. Thus, their responses cannot be explained in terms of performance error. Second, only a small percentage of participants mentioned the possibility of alternative (internal) manifestations. Thus, non-subtracted bodily feelings cannot fully explain participants’ affirmative responses to the post-subtraction question.

At this point, it is important to note that the results here do not question that bodily feelings play an important role in emotion. As it has been noted, subtracting the feelings of bodily changes had an impact on emotion ratings. This subtraction, however, didn’t preclude emotion. Most participants still considered themselves to be afraid (angry, sad) after the subtraction. This suggests that, against Embodied theories, bodily changes are not essential to emotion.

However, one could argue that there is an important distinction to be made here. In particular, the distinction between hypothetical and actual emotions. Although hypothetical emotions (the ones studied in this study) could exist without bodily feelings, actual emotional experiences might necessarily involve bodily feelings. In the next section, I will present the results of a follow-up study designed to address this worry.

5. **Study 2**

In order to test whether actual emotional experiences necessarily involve bodily feelings, I reran Study 1 with some important modifications. Instead of asking participants to imagine an emotion, this new study used an autobiographical recall task to induce emotion in
participants. Autobiographical recall is a common method for inducing emotions in experimental settings. In autobiographical recall tasks, participants are asked to think about a situation in which they felt a strong emotion (e.g. fear) and describe it in detail. A recent review (Siedlecka and Denson 2019) shows that autobiographical recall reliably influences subjective emotional experience as well as physiological responses such as changes in heart rate and blood pressure. As participants describe the situations that triggered their emotions in the past, they come to experience the relevant emotion again, as well as the associated bodily changes.

5.1. Method

Participants\(^{16}\) first completed the emotion induction task. They were told to ‘Please think of a situation that made you extremely afraid (angry, sad). Vividly recall what happened and how you felt, and write it in the box below. Take at least two minutes to give as much detail as possible’. Afterwards, participants rated on a scale from 0 (‘not at all’) to 6 (‘very much’) the extent to which they were currently experiencing: (1) fear (anger, sadness) as well as (2) bodily changes (heart pounding / muscles tensing / blushing / other). Then, participants went through the subtraction task. Instead of using James’ original wording, which could be problematic, participants were simply told: ‘Now imagine that you don’t feel any changes in your body’, and answered the question ‘Would you still consider yourself to be afraid (angry, sad)?’ on a scale from 0 (‘not at all’) to 6 (‘very much’).

\(^{16}\) 99 participants were recruited through Amazon Mechanical Turk and completed the survey for a monetary payment. They were randomly assigned to one of our three cases (fear, anger, sadness). 19 participants did not complete the survey and 7 participants did not report emotion after the induction. These participants were excluded, leaving a final sample of 73 participants (41 male, 32 female, 1 other, \(M_{age} = 35.32, SD = 10.55\), age range 23-69). Post-hoc power analyses using G*Power showed that we had 99% power to detect an effect of \(d = .5\).
5.2. Results

Replicating the results of Study 1, pre-subtraction emotion ratings ($\text{Mean} = 4.05, \text{SD} = 1.487$) were significantly higher than post-subtraction emotion ratings ($\text{Mean} = 3.45, \text{SD} = 1.743$), $p = .005, d = .368$,\(^{17}\) but post-subtraction emotion ratings ($\text{Mean} = 3.45, \text{SD} = 1.743$) were significantly higher than James’ expected response ($0 – \text{‘not at all’}$), $p < .001, d = 1.979$ (see Figure 2).\(^{18}\) Most participants (93.5\%) gave ratings of 1 or higher in the post-subtraction question.

5.3. Discussion

The results of Study 2 suggest that, even in non-hypothetical cases, the absence of bodily feelings does not lead to the absence of emotion. Most participants (93.5\%) answered that they would still consider themselves to be afraid (angry, sad) after the subtraction. Furthermore, 11 out of 80 participants in the study (13.7\%) reported experiencing emotion but not bodily changes before the subtraction (right after the Autobiographical Recall task). This suggests that, contrary to objections, actual emotional experiences do not necessarily involve bodily feelings.

\(^{17}\) Non-parametric tests yielded similar results. Wilcoxon signed-rank test showed that pre-subtraction emotion ratings ($\text{Median} = 4$) were significantly higher than post-subtraction emotion ratings ($\text{Median} = 3$), $Z = -2.699, p = .007$.

\(^{18}\) Non-parametric tests yielded similar results. One-sample Kolmogorov-Smirnov Test showed that post-subtraction emotion ratings did not follow a normal distribution, $D(62) = .118, p = .031$. 
Figure 2. Mean pre- and post-subtraction emotion ratings by emotion category (Study 2). Error bars represent standard error of the mean.

6. General Discussion and Conclusions

As we have seen, the Subtraction Argument is the main argument for the claim that bodily changes are essential to emotion. Authors hold opposite intuitions regarding this thought experiment, creating a fundamental divide in emotion theory: the one between Embodied and Disembodied theories. In order to advance this debate, I conducted a series of studies testing people’s intuitions regarding the Subtraction Argument. The results of Study 1 suggest that most people’s intuitions do not support but rather deny the claim that bodily changes are essential to emotion. Participants in this study were told to imagine an emotional experience and afterwards subtract the bodily feelings from it. Most participants reported that their emotions would persist in the absence of bodily feelings. Results cannot be accounted for in
terms of participants’ reflection (as measured by the CRT) or introspective capacities (as measured by the PBCS), nor in terms of non-subtracted bodily feelings or a systematic performance error (as shown by text analyses of participants’ justifications of their responses). In Study 2, the results were replicated with regards to actual instead of hypothetical emotions. Instead of making participants imagine an emotional experience (as in Study 1), this study used an emotion induction task to elicit an emotional experience in participants. Again, most participants reported that their emotions would persist in the absence of bodily feelings. Furthermore, some participants indicated that they were experiencing emotion but not bodily feelings even before the subtraction. Overall, the results of both studies suggest bodily changes are not essential to emotion.

Our results here fit well with extant evidence regarding emotional experience in cases of impaired interoception due to, e.g. spinal cord injury. Because patients with spinal cord injuries lack bodily feedback, these cases constitute a non-hypothetical equivalent to the Subtraction Argument. In the Subtraction Argument, we are told to hypothetically eliminate the feelings of bodily changes from an emotional experience. After suffering a spinal cord injury, feelings of bodily changes are actually eliminated (to different degrees, depending on the position and severity of the injury). Some studies have found that patients with spinal cord injuries report decreases in their experience of emotion after the injury, with larger decreases for more severe or higher injuries (Hohmann 1966). However, other studies have found no decreases in emotional experience even after complete cervical injuries (Cobos et al. 2002). The study of other cases of impaired interoception, such as pure autonomic failure, has yielded similar results (for a comprehensive review, see Laird & Lacasse, 2014).

In order to defend their accounts from the evidence against it, proponents of Embodied theories of emotion have put forward different auxiliary hypotheses. Most importantly, it has
been claimed that we can *simulate* the feeling of bodily changes in the absence of real bodily feedback (Damasio 1994). However, the results of the studies presented in this paper suggest an alternative interpretation. Studies 1 and 2 showed that, for most people, subtracting the feelings of bodily changes does not lead to the absence of emotional experience. Instead of assuming that spinal cord injury patients still experience simulated bodily feelings, we now have a simpler explanation: for most people, emotional feelings persist without bodily feelings.

Finally, it is important to note that our results here concern people’s intuitions. One might be reluctant to take people’s intuitions about emotion as evidence for or against emotion theories. After all, laypeople might be massively wrong about the nature of emotion. In the introduction, we have seen how authors appeal to our intuitions to support their claims about the nature of emotion. But maybe they should not. Emotion theories deal with what emotions really are, not with people’s understanding of emotions. Thus, emotion theorists might be better off by just ignoring people’s intuitions. However, this move comes at a high cost. As it has already been noted (Scarantino 2012), the object of study or *explanandum* of emotion theories is people’s emotional experiences. A theory of emotion should account for the things that people refer to when they say we are angry, sad or afraid. Thus, if we ignore people’s reports, we might end up with a theory that is not a theory of emotion but rather a theory of something else.

Our results here suggest that a large number of people’s experiences of fear, anger, and sadness do not involve feelings of bodily changes. This pose a problem for Embodied theories of emotion. If Embodied Theories want to explain people’s emotional experiences, they should try to *explain away* this evidence in terms of some confounding factor. Here, I have considered different possible confounds: Participants’ reflection or interoception
capacities, non-subtracted bodily feelings, and performance errors. Our results, however, do not support any of these explanations. Future studies should further investigate ways in which Embodied theories can account for the challenge posed by our results here. As things stand now, the results favor Disembodied theories of emotion, which seem better suited than Embodied theories to account for people’s emotional experiences.

References


Foot, P. 1967. The problem of abortion and the doctrine of double effect.


Stich, Stephen, and Edouard Machery. 2018. A Possible Future For Philosophy. *The
