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SUBMITTED ARTICLE

Emotions in time: The temporal unity of emotion phenomenology

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Abstract

According to componential theories of emotional experience, emotional experiences are phenomenally complex in that they consist of experiential parts, which may include cognitive appraisals, bodily feelings and action tendencies. These componential theories face the problem of emotional unity: despite their complexity, emotional experiences also seem to be phenomenologically unified. Componential theories have to give an account of this unity. We argue that existing accounts of emotional unity fail and that instead emotional unity is an instance of experienced causal-temporal unity. We propose that felt emotional unity arises from our experience of the temporal-causal order of the world.

KEYWORDS

temporal experience, emotional experience, representation in cognitive science

1. INTRO

An extensive amount of research has studied the influence of emotional state on the experience of time. Happiness, boredom, fear, excitement, depression, and a range of other emotional states have all been shown to influence our perception of time (see discussion in Eagleman, 2008; Wittman & van Wassenhove, 2009). One could see this research as providing scientific backing to the folk wisdom of *time flies when you're having fun*, or *a watched pot never boils*.

In this paper, we want to study the reverse phenomenon. We want to investigate how our experience of time plays a role in the constitution of our emotional experiences. This has not been a significant topic of discussion. However, being clear about our experience of time can help solve what we call *the emotional unity problem*, which has been raised as a criticism against certain theories of emotion (Dancy, 2014; Döring, 2007; Hernandez, 2020; Prinz, 2004).

The emotional unity problem arises for theories that claim that emotional experiences consist of parts. These theories are sometimes called “componential theories of emotion” (Moors, Ellsworth, Scherer, & Frijda, 2013). For instance, an experience of fear may consist of both a cognitive component which evaluates a situation as “dangerous”, bodily sensations such as your heart beating faster, action tendencies, such as the drive to run away, and so on. The emotional unity problem is the following: Despite their being complex, emotions still strike us as unified experiences. These various components are arranged, or interact, in ways to produce in us unified experiences of fear, happiness, joy, sadness, and so forth. If an emotional experience consists of parts, and an emotional experience seems to be a unified whole, then we need an explanation for how these parts come together in a single experience.

Our solution is that emotional unity is an instance of experienced causal-temporal unity. We will present a theory of how events are experienced as occurring in a continuous causal-temporal order (with a focus on the experience of simultaneity). The phenomenology of this causal-temporal unity will make it such that experiences of organic wholes emerge out of experiential parts. We will show that emotional unity is an example of this phenomenon by arguing that emotions are experienced as causally and temporally unified events.

The paper goes as follows: In Section 2, we present a componential theory of emotion. The version we discuss characterizes emotions as having three components: appraisals, bodily feelings, and action tendencies. However, we are not committed to the claim that these three components are essential to an emotional experience. The insights of this paper apply to any theory that takes emotional experiences to consist of a number of components. In Section 3, we describe previous attempts to solve the emotional unity problem. In Section 4, we outline some recent findings concerning how we experience time and causation. In Section 5, we show how these insights about temporal and causal experience can provide us with an explanation of emotional unity. Section 6 deals with two objections that can be raised against the view developed in Section 5.

2. THE COMPONENTS OF EMOTION

In this Section, we will describe a version of the componential theory of emotion. We will focus on three components that are often appealed to by componential theories of emotions¹, yet our argument does not assume that these three components are essential to all emotions. As long as emotional experiences are complex the arguments that we put forward will hold.

To illustrate the view, consider the following example: Imagine a person, Nick, sees a spider on the window next to him. Nick, being afraid of spiders, is struck with an experience of fear. His heart rate increases. His body tenses. He gets the urge to move away from the spider. And he forms the judgment that the spider is dangerous. To Nick, he is struck with a unified experience of fear. That is what he notices when he introspects.

According to the componential theory of emotion, Nick's response consists of several components. First, emotional experiences have a bodily component: Nick will feel certain (complex) sensations in his body. He will feel his muscles tense, his heart rate increase, he will sense that he is breathing faster and in general, he will feel a heightened sense of energy. Emotional experiences have a bodily component. Your body will feel a certain way depending on what type of emotion you are experiencing.²

Second, emotional experiences have a cognitive or appraisal component. Nick's experience of fear directed at the spider on his window tells him that the spider is "dangerous" or "frightening". Each emotion somehow evaluates an object or event in the world. For instance, fear may be connected to danger, anger to offensiveness, sadness to loss, and there will be other evaluative states connected to other emotions.³

¹ Prominent defenders of appraisal theory include Arnold (1960), Scherer (2001, 2005), Frijda (2007), Lazarus (1991) and Robinson (2005). For a similar view, called "judgementalism", see (Nussbaum, 2001; Solomon, 1976).

² Some theories of emotion put these bodily feelings forward as the essence of emotion (for instance Damasio, 1999; James, 1884).

³ One can hold that each emotional type is connected to a certain evaluative property (Teroni, 2007). Or alternatively, one may take there to be certain evaluative components that are shared across emotions and other features distinguish these emotional types from one another (See Moors, 2017).

Third, emotions have a motivational/behavioral component (also known as an “action tendency”).⁴ Part of an emotional experience is an urge to act in a certain way. When Nick is afraid of the spider, he feels the urge to distance himself from the spider. In other cases, emotions may elicit other action tendencies. An experience of happiness in response to something in the environment might lead to behaviors that prolong one’s exposure to the relevant aspect of the world.⁵

According to the componential theory of emotion, Nick’s experience is complex. It consists of mental phenomena that could be experienced in isolation. He could have experienced a similar tensing of his muscles, urge to move, increase in heart rate, and so forth, in the absence of the other components. Yet, there is a sense in which these different components are bound together to form a unitary complex. Nick feels fear in response to the spider. Similar stories could be told for other emotions as well. Emotional experiences are experiences that somehow affect our entire mind.

As noted above, we are aware that the components of emotion we presented are controversial. One might disagree and think that there are more or fewer parts, or that we have mischaracterized these components.⁶ Nevertheless, the argument that we will put forward throughout the paper does not hinge on which components compose an emotion, but instead, simply rely on emotions being complex.

Emotional experiences have parts. How, then, are these parts unified into unified experiences? This is the emotional unity problem.

⁴ The idea of an action tendency was first introduced by Magda Arnold (1960) and was further developed by Nico Frijda (2007).

⁵ Often, the felt action tendency is explained in relation to bodily feelings. We can understand the changes that our bodies undergo in terms of “action readiness”. Our body prepares to act in an appropriate way to the emotionally represented phenomenon. We need to fight or flee, therefore certain hormones are released, heart rate goes up, our muscles tighten and so on (See also Deonna & Teroni, 2017; Scarantino, 2014). This may also be related to imperativist accounts of pleasure and pain (see Martinez, 2011; Barlassina & Hayward, 2019).

⁶ For instance, Scherer (2005) holds that motor expression component, such as vocal and facial expressions of emotion, is constitutive of an emotional experience, because one can arguably feel facial muscles and vocal cords change when expressing the emotion. A good case, however, could be made that we can count these feelings as being part of the aforementioned bodily symptoms.

3. THE EMOTIONAL UNITY PROBLEM

Prinz has argued against the componential approach by referring to what he calls the Problem of the Plenty. The Problem of Plenty asks: how does an emotional experience appear as a coherent whole if it is not a single state or representation (Prinz, 2004)? A problem for claiming that multiple components are constitutive of a singular emotional experience is that it seemingly fails to explain how an emotional experience is phenomenologically unified. In the example above, Nick is struck with fear, and not just with an assortment of unrelated experiences. This objection has been raised by several other authors (Dancy, 2014; Döring, 2007; see also Hernández, 2020 for discussion). All componential theories of emotion will have to face this objection and provide an explanation of this phenomenological unity. Without an explanation of this sort, the theories fail to account for the phenomenal experience that is so central to emotion.

Moors (2017) suggest that an emotional experience is just the sum of all the components becoming conscious (see also Frijda, 2007). This can be considered as the most parsimonious solution to the emotional unity problem: there is nothing more to conscious emotional experience than its different components becoming conscious. As a result, there is no need to posit a special phenomenon over and above the experience of the parts. Not all components of an emotional process have to become conscious on Moors's account. But every relevant state that becomes conscious is a component of an emotional experience. This solution seems to be what most psychologists opt for (for an overview see Moors, Ellsworth, Scherer & Frijda, 2013).

A similar account was proposed by Scherer (2004, 2005), which he called "synchronization". According to Scherer, emotional experiences consisted of multiple components that would cause a unified functional response in individuals. In order for these components to exert a coherent causal influence on the organism they would have to be synchronized and occur simultaneously. As a result, the simultaneous activity of these components would explain their phenomenal unity.

These explanations, by themselves, fail to account for the phenomenon in question. As we have described it, emotions, such as fear, sadness, anger, joy, and so forth are both experientially complex in that they are composed of multiple experiential parts, yet these parts cohere in such a way that there is a unity to the overall experience of the emotion. Merely appealing to the fact that these various components are conscious either at once or in close temporal proximity to one another does not explain this unity. Consider that when Nick, in the example above, sees the spider he is also conscious of many other aspects of his environment. He sees the visual features of the window, he may hear the sound of passing cars on the street, and smell the coffee coming in from the other room. All of these experiences are occurring over the same temporal interval, yet they are not experienced as parts of the emotion. They are not all part of the fear that Nick is experiencing. Only some of the features that Nick is experiencing at that moment are bound together into the unified emotional experience.

We can illustrate the shortcoming of their account by analogy to a similar phenomenon found in classic models of visual object perception (Treisman, 1988; Treisman & Gelade, 1980; Clark, 2004). We do not simply perceive the visual world as being populated by a complex array of features in space. We do not simply perceive the visual field as having colors, shapes, movement, and so forth painted on its surface that simply happen to move together. Rather, we see the visual world as containing bound objects—objects that have shapes, colors, movement, and so forth. There is a binding process of some sort that allows for disparate visual features to be experienced as unified objects. In the visual case, the story by which features are bound together to form object percepts is a complex one (Schneegans & Bay, 2019; Wolfe, 2020), yet it is an explanation of this sort that is needed to explain the unity of visual objects.

The proposals by Moors and Scherer do not address this issue. A mere combination of experiences is not sufficient for those experiences to be experienced as unified. Something further is needed. In this case, something further is needed that explains how emotions are experienced as unified while they are also experientially complex. Something must bind the emotional components together. In the following sections, we propose that what binds emotional experiences together is a causal-temporal unity.

4. TEMPORAL UNITY

The task then is to provide an account of what unifies the individual components of an emotional experience in such a way that they are experienced *together as a phenomenal whole*. The proposal we defend is that this unity is provided by our experience of events in the world, and our own mental states, as inhabiting a common temporal-causal order. That is, the phenomenal unity of emotion is explained by the experience of temporal and causal relations and how these relations segment the world into events.

It is important to clarify the sense in which we aim to provide an account of phenomenal unity. We are not attempting to provide an overall account of the unity of consciousness. That is, we are not attempting to provide an account of the unified phenomenal field (Bayne, 2010) or of the co-consciousness relation (Dainton, 2008). The unity of consciousness, as these theorists attempt to understand it, is characterized by how various experiences of objects and events strike us as being part of a single unified field. Our target is far more modest. We attempt to provide an account of how objects and events, with various experiential components / properties, can strike us as unified wholes. In discussing the unity of consciousness, Bayne (2010) distinguishes that phenomenon from something similar to our phenomenon of interest by distinguishing the unity of consciousness from “object unity”. Our target is similar to that of object unity, but instead, we want to explain how mental events appear phenomenally unified. That is our target and what we believe is needed to account for the phenomenal unity of emotional experiences.

Let us begin by laying out some general points about our experience of time, and then we’ll apply these points to the emotional unity problem in the next section. We detect events in the world through our various sensory systems. We perceive external events through vision, audition, touch, and so forth, and we detect internal events (e.g., changes in heart rate, location of our limbs, extension and contraction of muscles, pains, pleasures, etc.) through the various interoceptive sensory systems. Introspection, whether it is thought of as a quasi-sensory capacity or not, provides us with access to mental events (e.g., occurrent thoughts and experiences). While not all of these events appear to us as having a spatial location (e.g., it’s difficult to say on the basis of introspection *where* a thought about a tv show occurs), all of these events are capable of being located within a common temporal dimension. We can often say, without difficulty, whether a thought’s coming to mind occurred prior to or after some event in the world (e.g., the question “did the thought strike you before or after you heard the

crash?” often has a sensible answer.).

Importantly, the temporal ordering that we experience these events as occurring often comes apart both from the objective timing of those events in the world and even from the timing of the initial sensory processing of those events. Empirical work on the flexibility of temporal order perception shows that without any changes in the timing of external stimuli, and without causing any changes in the timing of sensory responses to those external events, we can come to experience these events as standing in radically different temporal orders (see summaries of this work in Viera, 2021; Vroomens & Keetels, 2010).

To illustrate how the apparent timing of events comes apart from their objective timing and the timing of our sensory responses to those events consider a well-known study by Stetson et al. (2006).⁷ In this study subjects were placed in front of a monitor and asked to press a button. In the *initial* condition a flash of light would appear on average 35ms after the button press. In this condition, subjects reliably perceived the flash of light as occurring after their button presses. Subjects also felt as though they had some control over the production of the light – i.e., that the button press was causing the light to appear. The experimenters then introduced a second block of trials in which they inserted a delay between the button press and the flash of light. In this *delay condition* the flashes of light would appear on average 135ms after the button press. An interesting and well-documented temporal recalibration effect occurs in conditions such as these where a temporal delay is inserted between two apparently causally related events. As more trials in this condition are presented to the subjects, the apparent temporal delay between the two events begins to shrink. That is, without any shifting in the timing of the flash of light and the button presses, subjects begin to perceive these apparently causally related events as occurring closer in time than they originally did at the beginning of the block of trials (see the original Stetson et al. paper for details on how this is measured). There is a temporal adaptation or recalibration effect at play here whereby the perceptual system adjusts how it perceives events in the world in response to recent stimulation.

The truly striking effect, however, occurred in the third block of trials. After subjects had undergone temporal recalibration during the second condition, experimenters presented a block of trials with the exact stimulus conditions as the initial block. The only difference between the

⁷ See Cunningham et al (2001); Heron et al (2009) for similar results.

initial condition and this *post-delay* condition was that the post-delay block of trials was presented after the recalibration effects of the second condition had taken hold. Once again the flashes of light would appear on average 35ms after the button presses, however, in this condition subjects reliably perceived the flashes of light as occurring *prior to* the button presses! There was an apparent flip of the perceived temporal order of events despite there being no change in the stimulus conditions.

As described so far, this study shows that the apparent timing of events can come apart from the objective timing of those events in the world, but it does not show by itself that the apparent timing of events can come apart from the timing of our initial sensory processing of those events. The behavioral evidence is compatible with their temporal order recalibration relying on a shift in the timing of initial sensory processing of the relevant events. For instance, recalibration could be brought about by there being a delay in the processing of the tactile / haptic signal brought about by the button press so that the visual stimulus is processed before the button press is processed. However, subsequent studies have shown that temporal recalibration does not need to rely on shifts in the timing of initial sensory processes. The initial Stetson et al. study presented some of this data. Some of the subjects in the above experiment were also imaged using fMRI. In these imaging studies no difference in the timing of sensory processes could be detected between the initial condition and the post-delay condition.

Noting that fMRI lacks the temporal resolution to properly investigate whether temporal order recalibration effects involved a shift in the timing of sensory processes, subsequent studies ran similar recalibration experiments in tandem with MEG and EEG ERP studies (Simon et al., 2017; Stekelenburg et al., 2011). In these studies once again it was shown that temporal recalibration effects did not rely on their being a shift in the timing of our initial sensory processing of the perceived events.⁸ The apparent timing of events comes apart not only from the objective timing of those events in the world but also from our initial sensory processing of those events. Something other than the timing of sensory processing and events in the world must be determining the apparent temporal order of events in experience.

What then guides the apparent ordering of events along a common timeline? While the story

⁸ What these studies did find, along with the Stetson et al. study, was that recalibration effects correlated with activity outside of primary & secondary sensory cortices.

seems to be complex, the evidence suggests that the mechanisms that guide the ordering of events, perceived through multiple modalities, aim to produce representations of a coherent temporal-causal ordering (for discussion see Hoerl et al., 2020; Jagini, 2021; Umemura, 2017). That is, the mechanisms are such that in normal conditions they order events in such a way that causes precede their effects and that therefore allows an individual organism to navigate and make sense of its environment.

A striking example of the influence of apparent causal structure on temporal perception comes from a study by Bechlivanidis & Lagnado (2016). In their study, the perceived temporal order of when three objects began to move could be altered by controlling the cues used for detecting Michotte-style causal influences (e.g., intersecting paths, etc.).⁹ In this study subjects were presented with a three-item pseudo-causal display consisting of three equally spaced squares on a horizontal line. Square A (the leftmost square) would move to the right and “touch” Square B (the center square). In one condition, *the causal condition*, B would then move and “touch” Square C (the rightmost square) at which point C would begin to move to the right. Subjects were then shown two sequences and asked to identify which they had been presented with. One clip would be a video where the B moved before C, which matched the initial display, and another in which C moved before B. In this condition, subjects reliably reported that they saw the correct sequence in which B moved before C.

In the subsequent conditions, the Michotte-launching relationships were broken in different ways. In condition 2, the *dynamic non-causal condition*, A would touch B as normal, but C would begin to move before B would. In condition 3, the *static non-causal condition*, the Michotte-launching relations were further broken in that B would never move. In both conditions, subjects were given the same task as in the first. They were shown two clips and asked to identify which clip they had seen. One clip would show a standard causal situation in which B moved before C, while the other would show the stimulus sequence the subjects were initially presented with in that trial. In both conditions subjects were also asked to report the

⁹ Michotte-style experiments are classics in the perceptual psychology literature in which simple objects moving about a display appear to causally influence each other as a result of various spatio-temporal relationships – e.g., when one figure comes into contact with another and the second begin to move along the direction of movement of the first, then we tend to see this interaction as a causal interaction. Of course, since these are simply shapes in a display there is no genuine causal relationship between them. Yet, we cannot help but see the scene as involving a causal interaction.

apparent causal relationships between B and C. In condition two, where B in fact moved but after C, subjects would reliably choose the clip that showed the standard causal sequence. That is, they would report having seen a sequence where B moved before C, when in fact, they were shown sequences in which C moved before B. In condition 3, the result was less pronounced, and subjects often reported seeing the clip that matched what they had seen. However, in both conditions, there was a correlation between judgments of causal relatedness between B and C and the subject's choosing of the clip that showed a standard causal relationship where B would move before C. It was apparent causal relatedness that drove judgments of temporal order.

Perceived temporal order seems to be sensitive to our ability to grasp the apparent causal structure of our world. The Bechlivanidis & Lagnado study showed that this influence can occur within vision. However, a series of studies, utilizing different experimental paradigms have shown that apparent causal structure influences perceived temporal order within and across sensory modalities.

The same phenomena can be found in temporal order effects that occur when we watch a movie in which the audio and visual tracks are misaligned (Vroomens & Keetels, 2010). If the audio-visual tracks are offset by up to 250ms, we will quickly adapt to this offset if the language spoken by the actors and the language heard in the audio track match (e.g., the movie isn't dubbed). However, if the audio track is in a language other than that being spoken, and as a result there are radical differences between the sounds we hear and the facial movements that would produce those sounds, then we do not adapt to this offset. The sounds could not be the causal effect of what we see. This is an important point. The apparent causal structure of the world provides us with cues that allow us to represent aspects of the world as coherent events. In the same-language case, the visual and auditory cues that we receive are used to determine the structure of events in the environment.

The temporal binding phenomena, illustrated by the study by Stetson et al (2007) described above, is another case in which apparent causal relationships influence perceived temporal ordering across sensory modalities. The temporal binding effect is a general perceptual phenomenon in which events that appear as standing in a cause-and-effect relationship will appear to occur closer in time than they in fact do (Hoerl et al., 2020). The Stetson et al study showed that this effect can hold between intentional action, touch, and vision. Yet, further studies have shown similar effects in which causal interpretations influence temporal

perception hold for tactile-auditory interactions (Buehner, 2012), visual-auditory interactions (Poonian et al., 2015), tactile-tactile interactions (Asai & Kanayama, 2012), and visual-visual interactions (Choi & Scholl, 2006, Shimojo, 2014).

The effect of apparent causal structure on temporal structure also extends to cognitive and perceptual-cognitive processing. To see how, consider that confabulations, both clinical and non-clinical, often involve temporal displacement of events. A patient with Alzheimer's who grew up near the beach but now lives in a nursing home, may misremember an event from their childhood as having taken place that morning. This is an extreme case of temporal displacement where an event they experienced is represented as occurring at a very different time. However, more mundane examples exist. In a study by Desantis and colleagues (2016), subjects were presented with a random-dot-kinematogram (RDK) and were taught that pressing one key would cause the RDK to briefly show coherent rightward movement, while pressing of another key would lead to coherent leftward movement. Subjects were then presented with trials in which coherent rightward or leftward motion would occur prior to their having pressed any button. If the direction of the coherent motion matched the button the subjects subsequently pressed, then they would come to experience their button press as having occurred prior to the coherent motion.

A common feature in many accounts of confabulation, which fits with both the longer timescale forms of confabulation that we are most familiar with, and those that occur on shorter timescales is that the reported temporal order of events is one that matches a preferred causal story (Coltheart, 2017). It is the causal relationship between events that determines how they strike the subject as being temporally ordered.

Even in the Stetson et al. study, where cause and effect appeared to be flipped, this holds. The mechanisms responsible for bringing about temporal order recalibration, those at work in the extended-delay condition, are attempting to produce a coherent temporal-causal representation of the world by bringing together perceived causes and effects. It's by rapidly altering the context in which these mechanisms are operating that leads them to produce the odd results that we find in that study.

To summarize: our experience of events, both internal and external, as standing in a common temporal ordering is not simply given to us by the timing of sensory stimulation or sensory

processing. Rather, the perceptual system takes a number of cues to locate events as occurring at particular moments in time. A critical cue that is used in perceptually locating events in time are perceived causal relations. Our experience of causation and our experience of time are closely intertwined. Temporal unity, as we are calling it, is then explained by a process, which often exploits causal principles in perception, whereby events are represented and experienced as occurring simultaneously.

5. EMOTIONAL UNITY

Here we can give an explanation of how temporal unity explains the phenomenal unity of emotional experience. It is not merely the fact that the various components of a complex experience are had at once, since that would not explain the phenomenal unity of the experience. The empirical results concerning the flexibility of temporal order perception show that simultaneity of sensory processes of distinct events is neither sufficient nor necessary for those events being experienced as occurring simultaneously. Rather, these experiences are *represented* as occurring simultaneously, having a common cause, and as being part of a single unified event. This temporal-causal unity is what will be described below.

The components of an emotion are temporally unified in the sense that the subject, experiencing a complex fear directed at a spider in the world, experiences all of the various fear components *as occurring at once*. It is not enough that these modality-specific experiences be processed at once, or that they occur at once, but rather, it is that they are experienced as occurring simultaneously. The evidence cited above concerning flexible temporal order perception shows that the mere simultaneity of sensory / perceptual processes alone doesn't guarantee their subjective simultaneity. The components of an emotion are phenomenally unified in this sense. Importantly, since not just external events, but internal bodily events, and internal mental events can be located in time, this temporal unity provides a representational resource that can apply to all aspects of the experiential components of emotional experiences.

However, these components are also experienced as occurring at the same time as other mental states – e.g., subjects will experience these components as simultaneous with other unrelated mental and sensory events. Nick might feel fear while he *hears unrelated sounds*, but these

sounds that Nick hears, are not experienced as part of the emotion. However, this is where the causal component also plays into the felt unity. The various bodily states are taken to be caused by the target of the appraisal – they are experienced as a unified response. A singular event that is caused by the target of the emotion. The bodily sensation is taken to be caused by the spider, and this is in part, an explanation of why there is often a felt temporal order to first experiencing the look of the spider, then experiencing the fear. As noted above, the causal judgment and the temporal judgments relate to one another in that apparent causal relations influence temporal perception and apparent temporal relations influence causal perception. As a result, by taking the various components of an emotion to be produced by a certain stimulus in the world, those components come to be represented as a simultaneous response to (i.e., causal effect of) the relevant target of the cognitive appraisal.

The felt unity of emotional experience is thus both temporal and causal. The components of the emotional experience are experienced as occurring simultaneously. But they also form a unity, distinguishing themselves from other simultaneously occurring mental events, because they have a common cause. The emotional experience is experienced as a unified effect of some target state of affairs. In the case of Nick, the emotion is a temporally and causally unified effect of having seen the spider.¹⁰

Furthermore, our account helps us understand cases of emotional misattribution. We often mistakenly attribute our emotional state towards things in the world. I might feel anger over something that I have done, but in the throes of this emotional state, I misattribute the cause of my anger and instead take my anger to be directed at my neighbor. Or alternatively, I might take the bodily discomfort I am feeling due to having not eaten enough and having had too much coffee and misattribute annoyance towards someone around me. In all of these cases, I am undergoing a unified emotional experience, but the unity of the experience is not due to anything about the mere co-occurrence of the components of the experience. Rather, the unity arises from my taking some aspect of the world to be the cause of these various components that I experience as occurring simultaneously. Cases of misattribution show that there is already a role for causal judgment in our experience of emotion. Our theory explains further what role

¹⁰ The experience of the spider in our example is often described in the philosophy of emotion literature as the cognitive base of the emotion (Deonna & Teroni, 2015). In our account, the cognitive base is experienced as the cause of the temporally and causally unified emotional experience.

this temporal-causal experience plays.

6. OBJECTIONS

6.1. Temporal-causal unity is too broad

An objection one could raise is that our account predicts that some mental states should be experienced as part of a unified emotional experience when in fact they are not. Consider again our example of Nick's fear of the spider. When Nick sees the spider, this causes in him a complex array of effects. Some of these effects, such as increased heart rate, increase in body temperature, flight preparedness, and the appraisal of the spider as dangerous are experienced as parts of a unified fear response. However, the sight of the spider may have other effects that are not unified with the overall fear response. Nick might also have the thought that he should close the window, or that the spider is hairy, or that he should buy a brighter light bulb for the kitchen. Not only might these thoughts be the causal effects of Nick's seeing the spider, but Nick may experience these thoughts as being caused by his seeing of the spider and he may experience these thoughts as occurring simultaneously with his fear response (or at least, as occurring over an overlapping temporal interval). Yet, wouldn't our theory, as described above, predict that these extraneous thoughts caused by seeing the spider would be unified with the experience of fear?

Our theory, however, can account for this. Recall that what binds the various components of an emotional experience into a unified experience is that those components are experienced as occurring simultaneously and that those components are experienced as being a unified causal effect of the state of affairs that is the target of the appraisal. The key aspect of this analysis in responding to this objection is that the various components of an emotional experience are unified as a single common effect of a state of affairs in the world – i.e., as a unified event. These emotional components being part of a single effect does not require that all perceived effects of some state of affairs are combined into a single effect. A single cause may have multiple effects. Emotional experiences are experienced as a unified event that is caused by some feature of the world.

Consider another perceptual case. While playing billiards, the cue ball is struck and it simultaneously hits the 9 and the 10 balls. The two balls head off in distinct directions. In this

case, we readily experience this sequence as one in which a common cause causes two distinct effects. Why are the movements of these two balls experienced as distinct effects of a common cause? While causal judgment is a complex psychological phenomenon, one explanation is that the two balls exhibit a counterfactual independence. One can imagine that one of the balls could have been missing while the causal interaction between the cue ball and the remaining ball remains as before (Hagmeyer et al., 2007). Our causal reasoning capacities are sensitive to the possibility of selectively intervening on distinct effects in order to judge their distinctness. As a result, we take this causal interaction to result in two distinct effects rather than one.

Turning back to the emotion case, why then are the emotional components taken to be a unified effect of having seen the spider, while the occurrent thoughts that come to Nick's mind as a result of seeing the spider are not unified with the emotion? The various components of Nick's fear could all be had independently. However, what is distinctive of fear, as opposed to some other emotion, is that these components tend to co-occur. Event segmentation is known to be sensitive to statistical dependencies between features of events, such that features that show statistical dependencies are bound together as parts of a common event, whereas co-occurrent features that lack this dependency are less likely bound to the same event (Tversky & Zacks, 2013). The same should hold for emotional experiences. The emotion is experienced as a unified event that is the effect of some cause.¹¹ That cause may have other effects, but because they do not share the correct statistical dependencies with other effects, they are not bound together as part of the same event. The emotional complex is a unified effect of having seen the spider, but this does not require that the emotional complex be experienced as the only effect of the perceptual episode.

One might worry that our response to this objection raises another problem.¹² We argued that one can distinguish between those effects of an event that form part of the unified emotional experience from those effects that do not form part of the emotional experience on the basis of

¹¹ In this essay, we are developing our account against the background of an appraisal theory of emotion. However, the model can be developed within any componential theory of emotions. As we have developed the point, the various emotional components that a subject experiences at any given moment are bound together as a unified effect of some cause – i.e., the target of the appraisal. However, the same event binding phenomenon can occur without an appreciation for their cause. If the emotional components that a subject experiences at a given time bear the proper statistical relationships with one another, then they can be bound together as components of a complex event. Thank you to an anonymous referee for pressing us on this issue.

¹² Thank you to an anonymous referee for raising this point.

how the components of the emotional experience are bound as a single effect. Yet, as the worry goes, even these experiential components that are unified in prototypical emotional experiences can be had independently of one another. For instance, suppose that Nick had taken a drug that suppresses increases in heart rate. When he encounters the spider, presumably he would lack the Increased heart rate, yet would still undergo a unified experience of fear consisting of multiple components. It seems as though the experience of fear does not necessitate that the subject experiences all of the components that typically occur with a fear reaction. Therefore, there is a worry that we have failed to account for the experiential unity of emotions.

In a related literature, this worry resembles what Prinz (2004) has called *the problem of the parts*. If emotions consist of parts, then we need to say which of those parts are essential to the emotion and which are not. Scherer (2001, 2005) names a number of subsystems as essential parts of emotion. Other emotion theories are less essentialist, such as Moors's (2017) account. While that debate concerns the metaphysics of emotions, our discussion here concerns a related but distinct topic concerning our experiences of emotions. If any individual component of the typical emotional response is missing, then two open empirical questions are raised. First, it becomes an empirical question as to whether or not the remaining features share the appropriate statistical relationships to then be bound together as a unified event. Second, even if the remaining emotional components are bound together as a single effect of some cause, it is an open question as to whether or not the subject would be able to recognize this response of theirs as any specific emotion. Nick, after taking drugs that selectively impair certain responses, may have a response upon seeing the spider, but not be able to categorize his emotional response as fear if it is lacking some highly typical features (e.g., physiological responses, action preparations, etc.).

6.2. Diachronic Unity

One might object that emotional unity should not be analysed in terms of synchronic unity – i.e., the unity that holds across experiences at a specific point in time. Rather, emotional experiences are primarily diachronic phenomena in that emotional experiences are episodes that unfold over time. Some have defended the claim that emotional experiences are diachronically unified in this way (Hernández, 2020; Robinson, 2005, 2018; see also Goldie,

2000). From an emphasis on the diachronic unity of emotions, one can raise two distinct types of objections against what we have argued for in this paper.

One could object to the very idea of synchronic unity. If this is the objection, however, then we should be able to see that the objection is misplaced.¹³ In the throes of an emotional experience, we can feel ourselves as being overwhelmed by bodily feelings and a drive to act that all strike us as being directed at, or caused, by some target of our appraisal. When Nick confronts the spider, the experience is not one of sequentially experiencing the different components of the emotion. Rather, they all strike him as occurring at once.¹⁴ This was the primary target of our analysis.

However, there is an alternative means of interpreting the objection. The objection is not targeting the very idea of a synchronic unity to emotion, but rather, the objection is that any synchronic unity to emotional experiences is dependent on there being a diachronic unity to emotional experiences. A way of putting the objection is that what qualifies an experience as an emotional experience is not something that can be captured by a snapshot of one's experience at a moment, but rather, is only captured by how the experience seems to unfold over time (see Hernández, 2020; Robinson, 2005, 2018).

While our analysis so far has been an analysis of a synchronic unity, our account is easily extended to a diachronic unity, and ultimately, makes no claim about which is primary. Events are often, if not typically, temporally extended. They extend over temporally continuous intervals. Experience, contrary to what some authors have argued (Chuard, 2011), does not merely present us with how the world is at a moment, but rather, our perceptual processes represent the world as it is over a temporally extended interval (Grush, 2005; Philips, 2010; Lee, 2014). Emotional experiences can be understood as having an experiential awareness of the unfolding of unified events that are the effect of a singular cause in the environment.

Similar points can be made for apparent causal relations. Causal relations, as given to us in experience, are diachronic relations that hold between temporally extended events. Taken together, our analysis applies equally well to an analysis of the diachronic unity of emotional experience. There are a series of emotional components and processes that impact our

¹³ Hernandez (2020) argues that emotions are diachronic phenomena, but they also admit that they possess synchronic unity as well. The objection we are engaging with in this paragraph should not be attributed to him.

¹⁴ Whether or not they all occur at once is not the point. Rather, the claim is about subjective simultaneity.

experience, these processes are taken to be a unified causal effect of some state of the world that is the target of an appraisal, and these processes occur over a common temporal interval. If these conditions hold, then, we argue, that these components will be experienced as part of a unified emotional experience. The problem of emotional unity can be overcome once we realize the role that our experience of time and causation play in our experiencing of emotion.

6.3. Does our account generalize beyond fear?

Fear has a special relation to time (see Bordini & Torrenco, 2022). Fear is future-oriented. Fear, as we have been discussing it, also bears an important relation to the object towards which the fear is directed. In our examples, Nick is afraid of the spider because of what might happen. A worry would be that the account we have developed so far exploits specific features of fear and as a result does not generalize.¹⁵ Let us consider a pair of cases that do not involve fear that show that the account developed does not depend on peculiar features of fear.

Lucy is riding her bike through a city in a painted cycle lane. All of a sudden, a car turns across the cycle lane and almost hits her. The driver yells out of their window telling Lucy to watch where she is going. Lucy feels that she was wronged. She feels her skin flush and get warm. Her heart starts to beat faster. She clenches her body and she feels the urge to yell at the driver to tell him how he was in the wrong. Lucy experiences herself as feeling anger as a result of these components being unified as a singular effect of an external cause. The model developed in this paper readily applies to this case.

Now, consider a case of nervousness. Jo has a test a week from today. When they think about the test, they experience muscle tension, dry mouth, shaky hands, nausea, and a host of other phenomena. They feel nervous. Importantly, it is the thought that triggers the feeling and not the event itself. Somehow, these experiential components are bound together as a complex event, but it is not clear what they are an effect of. On one interpretation, the object of the nervousness is the thought about the test. On another interpretation, the thought provides Jo with intentional access to the test, and it is this test which is taken to be the cause of the experienced emotion. On either interpretation, what explains the unity of the emotional experience is that the emotional components are experienced as simultaneous parts of a unified

¹⁵ Thank you to an anonymous referee for raising this point.

effect of some event.¹⁶

What we have given in this paper is an explanation for what binds the emotional components together into a unified whole. The phenomenal unity of emotional experiences is simply a product of binding emotional components into a coherent temporal and causal event structure.

7. CONCLUSION

In this paper, we described a componential theory of emotion in which bodily feelings, action tendencies and an appraisal are the components of emotional experience. We also described how despite emotional experiences having this complex structure, they may still strike us as phenomenally unified. The mere fact that multiple components of emotion are conscious does not explain their felt unity. In this paper, we have proposed an account of this felt unity that coheres with current cognitive science. Furthermore, this shows us how our experience of time can provide an unmysterious framework in virtue of which experiences can be phenomenally unified.

In this paper, we have simply mentioned a sketch of how our causal reasoning capacities enter into our emotional experience. The sketch is one that provides a framework for empirically investigating the way in which emotional experiences are unified. By manipulating causal cues, we should, in principle, be capable of altering one's emotional experience. Our account not only provides an introspectively and empirically plausible account of this phenomenon, but also provides an avenue for future research.

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¹⁶ Notice that nothing in our account exploits the future orientation of fear or of any emotion. The object of an emotion may be in the future, present, or past. What matters for us are the represented temporal relations between the experienced emotional components, and not how current experiences are temporally related to intentional targets of appraisal.

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