Time Perception and Emotion Awareness

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Abstract
One of the challenges of measuring emotion is the different timing of bodily responses, affective appraisals, and the emotional awareness which can be accurately self-reported. Although these are known to be correlated, more precise time-locking is often not possible because the precise trigger causing an affective subjective experience is not known. We propose a novel experimental paradigm to approximate affective triggers with a fine-grained temporal resolution, even for long elicitation stimuli. A Libet clock is used to determine the point in which a person becomes aware of their own emotions and facial expressions. By measuring simultaneously other bodily cues, we also estimate the trigger or the eliciting cue of the emotion. With this experimental paradigm, we expect to shed light on whether people are happy when they smile, or if they smile because they are happy.

Author Keywords
Time perception; Emotion awareness; Emotion elicitation; Affective responses measurement; Libet clock; Conscious experience.

Introduction
Emotions are processes that usually entail a felt affect which was triggered or elicited by a particular stimulus. These stimuli can be either endogenous, e.g., a thought,

or exogenous, e.g., a ball coming towards us. Moreover, they are systems of dynamically inter-related responses, including bodily changes such as facial expressions, posture, and other autonomic changes. These changes often co-occur with the affective experience, and it is still under debate whether they precede or follow the subjective experience of emotion. Besides the temporal relationship between affective triggers, body responses and subjective experience, there is also the awareness dimension. Whereas body changes occur at a fast-pace, conscious subjective experience might not be instantaneous. Some researchers have argued that the subjective experience of emotion is inextricably linked to consciousness [2]. Both, raw feelings and reflective cognition, contribute uniquely and interactively to shape current emotion experience [13]. Moreover, there are regulatory mechanisms which allow us to experience an emotion while inhibiting behaviours such as facial expressions, suggesting that the self-reported experience of emotion can remain unchanged even if there is a deficit of body reactions [7].

The intricate relationship between body cues, cognitive appraisal, and subjective experiences is one of the major challenges to shed light on the process of affective subjective experiences. Moreover, body cues such as facial expressions can be controlled voluntarily, cognitive appraisals cannot be measured directly, and self-reported measures are affected by a number of biases. These biases include the demand characteristics bias, or the tendency of participants to play a good role and respond according to their guess regarding their expected answer [11, 14]; and the social desirability bias, or the tendency of people to self-report inaccurately to present themselves in the best possible light [12]. Furthermore, up to now, the measurement time-resolution of self-report is rather coarse when compared to other physical measures such as autonomic responses, posture, or facial expressions. Whilst techniques such as the Experience Sampling Method (ESM) [8] provide a good approximation of what the user is feeling when using at periodic intervals, they also require a logging tool that intermittently prompts users to report their experience, and that ultimately alters the user's affective state. Even if such interruption is undesired, sometimes it is necessary to obtain rich qualitative feedback without relying on long term memory. Moreover, another challenge when assessing subjective experiences is the time warping effect caused by affective experiences, and different awareness levels across individuals [4]. Time perception is usually non-linear [17]; and emotions themselves alter time perception [5].

In summary, the relationship between affective triggers, whether endogenous or exogenous, body responses, cognitive appraisals, and self-report is still unclear. It is challenging to measure precise linkages between body changes and subjective experiences because physiological data has precise temporal structures but subjective reports stretch, shorten, and warp time. Perhaps if we could precisely time an incoming affective trigger, and subjective experience awareness onsets, this would provide a temporal cue to align each of the aforementioned components of affective processes. However, there is also a challenge with precise emotion elicitation. In their Handbook for Emotion Elicitation and Assessment, Coan and Allen (2007) listed several methods for emotion elicitation. These include elicitation using films, pictures, the directed facial action task, emotional behaviours, probes for unconscious processes, social psychological methods, dyadic interaction tasks, music, and primary reinforcers [3]. From these, film-based emotion elicitation seems the most predominant method in affective science, as it provides a good balance between ecological validity and experimental control. Using non-prerecorded stimuli introduces a degree of stimuli variability that can sel-

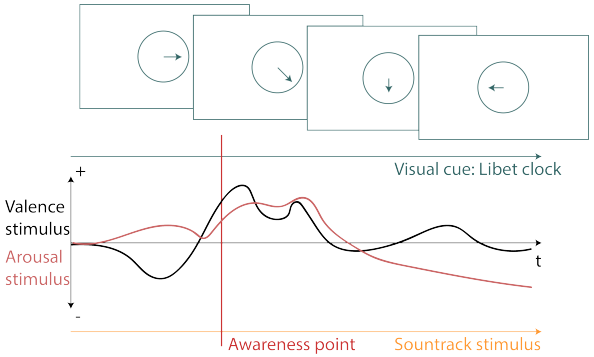

Figure 1: Proposed experimental paradigm. The participants listen a stimuli in a different modality to the Libet's clock presentation. When they become aware of their affective experience, they are asked to report the time the clock was pointing at. When several sensors are measured simultaneously to the task, this enables a better mapping of affective triggers, body responses, appraisal processes and self-reported subjective experience.

dom be afforded. Nevertheless, stimuli such as videos or music contain different levels of arousal and valence within the length of the stimuli. Since self-report is only asked after the stimuli, this again poses the challenge described for the ESM. Subjective reports have been taken only after the emotional events are gone, making it difficult to locate the onset of emotion in the time course of physiological data.

To address this challenges, we propose a novel experimental paradigm based on Libet's clock [10], which is often used to study free will.

A novel elicitation paradigm

Previous studies have shown that, facial expression awareness rates were 57.79% in real-time conditions and 75.92% in video-review conditions [15]. By using the Libet's clock approach, we aim to improve the temporal precision of self-awareness reports, without relying on memory or post-fact approaches such as video reviewing.

In agency studies, Libet's study was a landmark. Agency is defined as a sense of free will, or the sense that "I am the one causing my own actions" [6]. The study of free-will is similar to the study of cues of affect in the sense that the exact timing of the affect source is unknown. Just as volition is an intangible event that causes a limb to move, affect might be the cause of a certain facial expression. Conversely, there might be that a certain facial movement causes the experience of emotion [1]. In either case, the source of the subjective experience or the facial movements is also intangible.

A generalised Libet task involves a self-paced movement. A "clock" is used for estimating either the time of a movement or the time of being aware of the intention to move. Participants are asked to flex their right wrist or finger while attending a clock face made up of a revolving dot on a screen. There were three event types that participants reported: when they felt an "urge to move"; when they moved; and when they felt an unexpected skin stimulation. It was found that the time perception of the intention to move occurs about 200 ms prior to movement. The time of movement was perceived about 85 ms before movement onset. Finally, the time of sensory stimulation was reported about 50 ms prior to stimulation [10, 9, 16].

A similar approach can be used to measure affective awareness and affective responses. We propose to apply a Libet task to explore the relationship between affective triggers, body responses, appraisal processes and self-reported subjective experience (Figure 1). In this task, an affective state will be elicited with sound stimuli, while they look at a

Libet's clock. We choose different modalities to allow participants to focus on both stimuli as much as possible. Additionally, several sensors could be used to measure physiological and behavioural responses. Finally, when using external stimuli we can address elicited affective responses. However, participants could also be asked to produce self-paced facial expressions, for example, to investigate endogenously produced affective reactions.

Demo proposal

Our novel task can be demoed during the MEEC workshop. We propose to provide a portable version of the task and simultaneous eye-tracking. After participating, participants could get insights on what part of the stimuli was determined as the source for their experience. This would provide further food for thought and trigger further discussions during the MEEC workshop.

Conclusions and future directions

We believe that this experimental task has the potential to address some of the challenges of emotion elicitation and measurement. If a considerable amount of data is collected using it, perhaps we can shed light on the relationship between affective triggers, bodily responses, affective appraisals, emotion awareness and self-reported subjective experience. If a fixed relationship is modelled, this model would help to blindly estimate the affective trigger, or to investigate how bodily cues and affective triggers integrate to form a self-reported subjective experience.

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