When Seconds Turn into Minutes:

Time Expansion Experiences in Altered States of Consciousness

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Abstract: Time Expansion Experiences (TEEs) occur when a person's normal experience of time slows down or expands significantly. Previous research has associated them mainly with accidents, but also altered states of consciousness such as mystical experiences, psychedelic experiences and near-death experiences. This paper describes a qualitative study of 74 reports of 'Time Expansion Experiences' (also a pilot study of 22 reports) which investigated the phenomenology of such experiences, using thematic analysis to highlight the main themes. The most common triggers of TEEs in the study were accidents (40 of 74) followed by spiritual states (12) and then psychedelic experiences and sports and games (both 7). Many participants commented on the dramatic nature of their TEEs, with themes of positive affective states (most notably calmness), alertness, the opportunity to take preventative action (related to very rapid cognition) and quietness. Interpretations of TEEs are discussed, arguing against the theory that they are an illusion created by recollection. TEEs are seen as a characteristic of altered states of consciousness, which occur when the normal self-system dissolves in exceptional circumstances. Human beings' normal experience of time is a psychological construct, produced by the psychological structures and processes of the normal self-system.

keywords: time expansion experiences, accidents, altered states, mystical experiences, psychedelics

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A few years ago I had a car crash. I was driving in the middle lane of a motorway (highway, in the US), when a truck pulled out from the inside lane and hit the side of our car, spinning us around, and then hitting us again. As soon as the truck hit us, everything seemed to go into slow motion. I heard the sound of the impact and asked my wife "What was that noise?" Time seemed suspended, as if a "pause" button had been pressed. Then, after a long pause, the car began to spin. I looked behind and the other cars on the motorway seemed to be moving extremely slowly, almost as if they were stationery.

I felt as though I had a lot of time to observe the whole scene, and to try to regain control of the car. I was surprised by how clear and vivid everything became, and how much detail I was able to take in. I was also surprised at home calm I was. Rather than panicking, I thought clearly and methodically about the situation. I tried to regain control of the car, gripping the steering wheel and pressing down the brake, but the car kept on spinning, for what seemed at least half a minute (although in reality it could not have been more than a few **seconds**). Luckily, the car spun in the direction of the "hard shoulder" (the empty inside lane, received for breakdowns) of the motorway, and we finally careered into a crash barrier, without any injuries. Then everything seemed to switch back into normal time again.

This is an example of what I term a "time expansion experience" (TEE, for short). One popular term that has been used for such experiences is *tachypsychia*, defined as a neurological condition bringing altered or distorted time perception, often related to trauma, drugs or physical exertion (Amato, 2018). However, tachypsychia is used to refer to experiences of time-contraction as well as time-delation, so it is not appropriate term in the context of this paper.

This article will describe two studies (the first a pilot) which investigated these experiences. The pilot study was specifically focused on time expansion experiences in the context of accidents and emergencies, with the main purpose of identifying the main themes of the experiences (besides the primary characteristic of time expansion). The second full study elicited reports of TEEs generally, without specifying the context of accidents and emergencies. This second study had the added purpose of investigating the varieties of triggers of TEEs, and finding out which were the most common.

In the discussion section, further questions relating to TEEs will be discussed. I will examine some attempts to explain TEEs, including the idea that they are an illusory recollective phenomenon. Can TEEs be classed as spiritual experiences, or a higher state of consciousness? Can they be seen as an evolutionary adaptation, in the sense that an ability to slow down time gives us more opportunity to respond to dangerous situations, and so enhances our chances of survival? I will suggest that time expansion is a common feature of many altered states of consciousness, which indicates that human beings' "normal" experience of time is essentially a psychological construct, produced by the psychological processes and structures associated with a normal state of consciousness (or our normal 'self-system'). When we shift out of normal consciousness, we experience a different perception of time.

Dramatic TEEs

The first study of time-slowing in accidents was published in 1892, as *Notes on Fatal Flaws*, by the Swiss geologist Albert Heim. Heim had his own experience of time expansion when he fell from a precipice while mountain climbing. As he wrote, "What I felt and thought in those five to ten seconds cannot be told in ten times as many minutes…as if on a distant stage, my whole past life [was] playing itself out in numerous scenes" (in Phipps, 1980, p.150). This experience inspired Heim to

collect examples from other climbers. Almost all of his participants reported rapid thought processes - estimated to be a hundred times more intense than normal - with a sense of calmness and clarity. They felt that a massively expanded sense of time enabled them to react with lighting quick speed to their predicament.

Noyes and Kletti (1976, 1977) studied two samples of accident experiences. In both studies, around three quarters of participants reported a slowing down of time, while around a third of participants also reported extremely rapid thought processes. In addition, many of the subjects also reported heightened attention and alertness, and the ability to respond quickly and effectively to their predicament. Interestingly, Noyes and Kletti (1976, 1977) found that the experience was more likely to occur when participants believed that they were going to die. They also noted the importance of the events being sudden and unexpected. As Noyes and Kletti pointed out (1976, 1977) such experiences do not occur in hospital patients with serious illnesses, even though their lives are in danger.

In addition to accidents and emergencies, time-expansion experiences have been reported across a wide range of different situations, such as psychedelic substances, moments of peak performance in sports, mystical experiences and near-death experiences. As Bayne and Carter have put it (2018),"One key feature of the psychedelic state is a distorted experience of time, with subjects typically reporting that time has stopped or slowed" (p. 4) Or as Huxley (1988) put it poetically, psychedelics can "telescope aeons of blissful experience into one hour" (p. 27). This has been reported across a wide range of different psychedelic substances including DMT (Strassman, 2001), Ayahuasca (Shanon, 2001) and Salvinorin (Hanes, 2003).

There are certainly also many reports of TEEs amongst athletes, usually associated with the peak performance state of being "in the zone." Murphy and White (1995) cite numerous examples, including the short-distance runner Steve Williams, who reported that "If you do a 100 right…that 10 seconds seems like 60. Time switches to slow motion" (p. 107). Similarly, from another source (Dossey, 1982), an American footballer, John Brodie, described a frequent experience in which

"Time seems to slow down in an uncanny way, as if everything were moving in slow motion. It seems as if I have all the time in the world to watch the receivers run their patterns" (p. 170).

Mystical experiences may feature time expansion, but also sometimes a sense of timelessness. In mystical experiences, the boundary between the individual self and the world may seem to fade away, along with boundaries between seemingly separate entities. In a similar way, the distinctions between past, present and future may seem to dissolve away (Happold, 1970: Hood, 1975; Hardy, 1979). A good example of this comes from the British nature mystic Richard Jeffries, who reported a state of consciousness in which "I cannot understand time. It is eternity now…To the soul there is no past and no future; all is and well be ever, in now. For artificial purposes time is mutually agreed on, but really there is no such thing" (in Happold, 1970, p. 279).

Another unusual state of consciousness which is associated with time expansion is the near-death experience. In the sense I am using the term, a near-death experience occurs when a person appears to be neurologically and physiologically "dead" for a short period of time - following a cardiac arrest, for example - but, on resuscitation, reports that they have undergone a remarkable and powerful conscious experience. The phenomenology of NDEs is similar to mystical experiences, with an intense sense of wellbeing or euphoria, feelings of connectedness or unity, and heightened perception. To this extent, one could say that NDEs *include* mystical experiences (Taylor, 2018). However, NDEs have other significant experiential features, including an out of body experience, a sense of moving through a tunnel of darkness towards light, encountering deceased relatives and sometimes a "life review" (Fenwick & Fenwick, 1995; Sartori, 2014).

NDEs also - like mystical experiences - often feature dramatic time expansion, or a sense of timelessness. Greyson & Stevenson (1980) found that 79% of near-death experiences in a study featured anomalous temporal phenomenology. Or as Fenwick & Fenwick (1995) have put it, "Time is often changed in near-death experiences, and some people describe the period of the experience as being almost an eternity" (p. 98). Some people in NDEs experience an extreme expansion of **time** when they leave their bodies. They may only be outside them for a few seconds and yet undergo an

incredible range of experience**s** – **a** journey through the tunnel towards a light, encounters with deceased relatives or with beings of light, visions of other realms of reality, and so on. In terms of timelessness, there may a strong sense that linear time is an illusion. For example, one person who had an NDE after being electrocuted described an awareness of "The conventional distortion is the construct of a 'past', a 'now', and a 'future'... At the earliest level of my NDE journey that human construct fell away, that arrow of time" (in Bernstein, 2003, p.5).

Renz (2015) has also suggested that the *process* of dying - even without the phenomenology of the NDE - can feature a sense of timelessness. In her studies of the experiences of the dying, she has identified three stages of the process: pre-transition, transition, and post-transition. In the post-transition phase, the dying person lets go of fear, accepts death, and experiences a state of ego-transcendence and tranquility. As Renz has described it, this stage "sometimes lasts no more than a few minutes, at her times perhaps hours, in some rare cases days, there is an utterly different atmosphere, a state beyond time, space and body… This makes such moments seem eternal" (2015, p.41).

Less Intense Forms of TEEs

A different - less significant and dramatic - type of TEE is sometimes reported by individuals who travel to new environments, or who undergo significant life changes involving increased exposure to new and unfamiliar experiences. James (1950) identified this phenomenon in his discussion on time perception in *The Principles of Psychology*, suggesting that it was due to new experiences forming a larger number of memories. As he wrote, "a week of travel and sight-seeing may subtend an angle more like three weeks in the memory…The length in retrospect depends obviously on the multitudinousness of the memories which the time affords" (1950, p. 624).

In Taylor (2007) an information-processing theory of time perception is put forward, suggesting that the more information an individual processes during a period of time, the longer they

perceive that period of time to be. This theory is utilised to explain why new experiences seem to stretch time. In familiar environments, perception becomes automatized, so that reduced information processing occurs. However, with exposure to new experiences and environments, perception becomes de-automatized, bringing increased information processing.

In Taylor (2007) this theory is also utilized to explain the expansive time experience of young children., and the gradual speeding up which appears to take place with age. Young children constantly undergo new experiences, and perceive the world directly and vividly. However, adults are exposed to progressively fewer new experiences. In addition, a process of increasing familiarization and desensitization occurs in relation to experience in general. This means there is progressively less processing of perceptual and sensory information. A link between increased information processing and time perception has also been suggested by Ornstein (1969) and more recently by Haguro et al. (2012).

However, the type of TEEs generated by newness and unfamiliarity should be seen as qualitatively different from the more dramatic TEEs generated by by accidents, psychedelics and mystical experiences. The degree of time expansion they bring appears to be less significant - that is, the individual's experience of time does not expand to the same dramatic extent. Newness and unfamiliarity do not involve the sense of stepping into a completely different "timeworld" in which time moves so slowly that it almost seems to disappear.

While researching to try to make sense of her experience, one participant (P11) of this study reported that she had come across the theory that her accident-related TEE could have been a retrospective effect, due to the creation of more memories in a state of high alertness (Stetson et al., 2007). However, as well as feeling strongly that the time expansion was a real phenomenon that occurred *at the time* of the accident, she felt that the theory could not account for the *extent* of her time expansion. As she said, "Yes, making novel new memories slows the perception of time, but it makes a day feel like a day and a half, not seconds into minutes."

A similar, less intense form of TEE has also been identified as an effect of mindfulness or meditation. Kramer et al. (2013) found that mindfulness meditation bought about an "overestimation of durations," suggesting an expanded experience of time. This applies both to short single mediation session, and as a long term effect of regular mediation practice (Berkovich-Ohana, Glicksohn, & Goldstein, 2011, 2012; Droit-Volet, Fanget, & Dambrun, 2015). Beyond time-estimation studies, there also many subjective reports of mindfulness meditation practitioners which mention a slowing down of time, as if the present moment has expanded (Kabat-Zinn, 2005). It may be that, as Deikman (!980) suggested, meditative practices may bring about a de-automatization of perception, similar to the effect of unfamiliar environments, which allows increased information processing. Again, however, this appears to be a relatively mild form of time expansion, compared to accidents and emergencies.

One should also note that there are certain negative states - such as boredom, anxiety and depression - in which time seems to expand (Wyrick and Wyrick, 1977; Gil & Droit-Volet, 2009; Droit-Volet & Gil, 2011). In duration estimation studies, fear and threat have also been associated with a slowing down of time (Campbell and Bryant, 2007; Anderson et al., 2007). In Taylor (2007) these experiences are also explained in terms of an information processing theory of time perception, based on the principle that such negative states prevent the focussing and absorption of attention. As a result. they feature a much higher than usual amount of subjective associational cognitive activity, involving rumination, imagination and involuntary "thought chatter" (Taylor, 2007). Associational cognitive activity is also a form of information, and so, at a high level, it also brings about an expansion of time. (Csikszentmihalyi, 1992, refers to this as "psychic entropy" and suggests that it is absent in flow. It is perhaps the main reason why time is reported as passing very quickly in flow.)

In my view, however - as with the time expansion associated with unfamiliarity and mindfulness - the negative states described above are qualitatively different from the dramatic TEEs triggered by accidents (or psychedelic or mystical experiences). Perhaps the most important factor is

that none of these situations involve a distinct and fully-fledged altered state of consciousness. In situations of newness and unfamiliarity, and in states of depression or anxiety, the same self-system is still functioning, with essentially the same psychological processes and structures. However, in dramatic TEEs, there appears to be a shift out of the normal self-system, in which our experience of reality (including our experience of time) alters.

Pilot Study - Summary

In a pilot study, 22 examples of Time Expansion Experiences in accidents and emergency situations were collected from 18 participants (m=11, f=7), who were all US citizens. Following ethical approval, participants were collected in response to an article on a popular psychology website, and via social media. Participants provided reports by email. Reports varied in length from 96 to 768 words. Some participants were recontacted to elicit further details. The reports then underwent a thematic analysis (Braun & Clarke, 2006) to elicit their main characteristics. The analysis entailed a process of deep engagement with the data. Units of meaning were grouped into clusters, becoming significant codes or themes. A number of main themes emerged with connected subordinate themes.

14 of these reports were from traffic accidents, 4 were from falls, and one each from a sexual assault, a fight, a fire and a feinting. A thematic analysis showed that the most common theme of the reports (mentioned in 18 of the 22 cases) was a positive affective state (primarily an unexpected state of calmness, with subordinate themes of wellbeing and bliss). The second most common theme was a sense that time-expansion enabled the participants to take preventative action and act methodically and effectively in a way that would normally have been impossible. For many participants, this was connected to very rapid and detailed thought processes. This theme was mentioned by 15 out of the 22 participants. (It should also be noted that in some of the other cases there was no possibility of preventive action - in a case of feinting, for example, or as a passenger in a car). The third significant theme was alertness, with an usual clarity of perception and heightened

awareness, mentioned in 10 reports. These findings were very similar to those of Heim and Noyes and Kletti (1976, 1977).

Full Study - Summary

In a more thorough and detailed study, it was decided to examine a wider range of TEEs, without specifying the context of accidents and emergencies. A request for reports of TEEs was distributed through social media (my own social media accounts and also those of my university), as follows: "I'm about to begin a research project on unusual experiences of time. Has anyone had an experience when time has slowed down drastically (e.g. in an accident, in meditation, psychedelics etc.)? If you have, and would like to take part in the research, please contact me."

Participants were simply asked to provide written accounts of their experiences, describing them in as much detail as possible. 74 reports were collected, from 60 (m=22, f=38) participants. Most participants were US citizens (28) with 21 participants from the UK, 3 from Canada, 2 from Germany, 3 from Australia, and 1 from Denmark, Greece and South Africa. Reports varied in length from 88 to 1051 words. Some participants were recontacted to elicit further details. The reports then underwent a thematic analysis to elicit their main characteristics, in the same manner as the pilot study (Braun & Clarke, 2006).

In this study, accidents and emergencies were the most common trigger of TEEs. Table 1 summarizes the overall triggers. Of the 40 related to different forms of accidents and emergencies, traffic accidents the most common (30), with other varieties such as falls, violent attacks and health emergencies. In a separate but similar category, there were 3 cases of shock related to traumatic or tragic events - specifically, bereavement, diagnosis of cancer and the breakdown of a marriage. Of the 31 remaining TEEs, there were three other significant categories: 12 were linked to spiritual practices (or spontaneous states) of meditation or presence, while 7 were linked to psychedelic substances and 7 were linked to sports or games.

Insert Table 1

Major Themes from Study 2

A thematic analysis of the 74 reports showed a number of prevalent themes. The most significant theme was positive affective states (primarily calmness, but also feelings of wellbeing, bliss or oneness) which occurred in 61 of the 74 reports. The second most prominent theme was alertness (with subordinate themes of heightened awareness, presence and clarity), which occurred in 39 of the reports. The theme of the ability to take preventative action, related to rapid and detailed thought process, was less prevalent than in the pilot study, presumably because only 40 of reports were related to accidents and emergencies). Table 1 below summarizes the five main themes, with subordinate themes in parentheses..

Insert Table 2

These themes will be discussed below and listed with some quotes from the participants to illustrate them.

Theme 1: Positive Affective States (subordinate themes: calmness, detachment, lack of anxiety about danger, sense of well-being, spiritual feelings)

A sense of calmness was described by almost everyone who experienced time-slowing during accident and emergencies, despite the potentially life-threatening danger of the situation. Feelings of wellbeing - not specifically calmness - were reported by participants across a wide range of other

reports. The following quotes illustrate the sense of calmness, detachment and well-being described by the participants:

P2 (meditation): I was meditating one day alone in the studio. The view was the point of the horizon meeting the sea and a tree in the distance. I suddenly felt very intense stillness, no breathing or awareness of body or surroundings. Time was standing still. Very peaceful.

P6, Experience 2 (listening to classical music): I heard the silence between the notes and it was breathtakingly beautiful…[M]y mind is completely empty during experiences like that and I feel like there is no me, There is only the music and the space between the notes. So it's more like time doesn't apply because there is no me to have perception of it.

P8: (car accident): A sense of calmness, being in the moment and detachment.

P15 (health emergency): The wasp had flown straight into my mouth and stung me. I couldn't breath and it felt like this was possibly it. I felt okay about it (despite the years prior to having somewhat of a death anxiety) and felt pretty calm.

P17 (accident - falling off a horse): I was ultra calm, unconcerned about the potential that the horse still hadn't recovered it's balance and quite possibly could fall on top of me disabling or killing me. My thoughts were only, "I wonder where the horse is? " When the horse did pass me and knocked my head I was still unconcerned and didn't feel a thing then or when I hit the ground.

P32 (car accident): Some years ago my daughter and myself were hit by a van as we rounded a bend in the road while I was driving. We both experienced the slowing down experience and a calmness

. The window screen shattered in slow motion and neither of us experienced any panic until we sort of came out of this sort of trance.

Theme 2: Alertness (subordinate themes: heightened awareness, presence, clarity, quietness)

The sense of alertness was described in terms of vivid, intense perception, with a sense of being intensely present and focused. The other prevalent theme (at least amongst the accident and emergency situations) was a feeling that the slowed down sense of time enabled them to take preventative action to avert danger, or protect themselves. As with the sense of calmness, the sense of alertness was sometimes described in spiritual terms, even if the experience was triggered by accidents or emergencies. Some participants described this aspect of their TEEs in spiritual terms (for example, P31 and P36 below):

P9 (diagnosis of cancer): Just before I was diagnosed with breast cancer as I was sitting in the waiting room. I intuitively knew what the outcome of the tests were and as I sat in the waiting room everything slowed down ... the people walking on the sidewalk outside the window and everything in the office as well. The smells, sounds and sights were very vivid.

P14 (mortar attack as soldier): I could see the shock waves and shrapnel as they exploded which mostly happens too quick to be of any note. Or at least I'd never noticed it before. I was more aware of what others were doing or where they were. There is a base plate detector that sends rockets back instantly to destroy the mortar placement, even the return rocket seemed to glide slowly through the sky quite uncharacteristic of a rocket.

P31 (traumatic life event - decision to separate from husband): The moment I 'embodied that decision' I experienced sudden burst of clarity and energy expansion, I can't really express it well in words, but from the grief over 'my loss' time stood still for a moment…it created such an intense sense of presence in me and peace, sense of space and 'light' which sounds a bit silly I know but

that's how it felt or rather was experienced, its not a feeling like we have of cold of hot, or happy or angry.

P36 (explosion): Extreme attention to detail, sound, movement. I was everywhere all at once…Aware of internal and external processes. As if I had a massive self witnessing all. Watching people respond with incredible speed, strength and agility, but in slow motion at the same time. Sound was loudly silent if that makes sense.

Theme 3: Extraordinary and dramatic nature of time expansion (seconds turning into minutes, sense of timelessness, or that time had stopped or disappeared)

Participants were not asked to comment specifically on how much time they felt had elapsed (which was also the case with the pilot study) during the experience (in contrast to how much clock time had elapsed), but some participants did make statements in relation to this. Some participants appeared to experience a *modest* degree of time expansion. For example P5 reported that, in a car accident, "I was probably sliding for, at a guess, 10 to 15 seconds but it seemed more like 30 seconds." However, other participants reported that their experience of time was *dramatically* extended, in an extraordinary and unexpected manner. This was frequently described in terms of seconds turning into minutes. Some participants - particularly in cases of TEEs induced by psychedelics or meditation - reported that time seemed to stop or disappear altogether.

P3, Experience 2 (hockey game): The play which seemed to last for about 10 minutes ... all occurred in the space of about 8 seconds.

P7 (car accident): It seemed as though this took minutes, but it all happened with a second or two.

P12 (inhaling butane gas). A few seconds was like hours.

P17 (accident - falling off a horse): It only lasted a few seconds for me to be thrown from the horse and hit the ground; however the whole experience seemed to last for minutes.

P27 (intense interpersonal contact): Time slowed down and then completely stopped. Everything around us was a blur.

P51 (meditation): The self disappeared along with the past, the future and the passage of time. Everything just happened. There was no before or after. There was expansiveness and the joy of the lack fear, because there was nothing that could be afraid.

Theme 4: Opportunity to take preventative action (subordinate themes: rapid, detailed thinking; more time to make decisions and take actions)

As one would expect, this theme was prevalent amongst accidents and emergencies. (Although in some of these situations, participants were unable to take preventative action - for example, because they were a passenger in a car in an accident.) In other situations, such as meditation or psychedelics, the issue of preventative action was obviously not relevant. In two cases of competitive games, there was a similar phenomenon of feeling that there was more time available to act and respond, conferring an advantage in the game. This category includes the sub-theme of rapid, detailed thinking, which was reported by some participants as enabling preventative action.

P5 (car accident): I seemed to have so much time. Don't touch the steering wheel, I'm sliding in the right direction, towards the hard shoulder! Look back up the motorway, is anything coming towards me, no, ok if there is I have time to abandon ship. My head was really clear because I seemed to

have so much time to think…I will always remember how much time I seemed to have to think and work things out.

P8 (car accident): Time slowed for me as I was about to get in a car accident. It allowed me time to react and divert a major accident.

P42 (playing video game in deep absorption): Everything seemed to occur at about half the normal speed. I was able to look at other players actions, consider them and respond so rapidly that I found myself also able to consider many factors which usually I wouldn't have time to observe let alone consider and react to.

P43, Experience 1 (playing table tennis): The game turned into slow motion. I could see the ball and its flight and spin perfectly, anticipating its precise bounce and position my body, arm hands and wrist to hit perfect returns and sometimes from seemingly impossible positions where the ball was falling below table height and still hit winners. It was an experience sports stars would now call being 'in the zone.'

P55 (car accident): My thought processes were very detailed as I anticipated the car's changes in direction as it skidded and rolled towards me.

Theme 5: Quietness (subordinate themes: muffled noise, reduced awareness of surroundings)

Again, this was primarily a theme of TEEs triggered by accidents and emergencies, but was also linked to a variety of other TEEs - for example, a sports match and an experience of intense interpersonal contact. External noises seemed to become muffled or to disappear altogether, as if a

'mute' button had been pressed. Although it was primarily related to sound - a fading away of external noise - there was also an equivalent phenomenon reported in relation to vision, as if surroundings and objects beyond the immediate situation had become less vivid and apparent. This was not a significant theme, in that was only mentioned in 11 of the reports, but it is worth highlighting because of its unusual nature.

P3, Experience 2 (Sports match): At this point everything has what would best be described as "tunnel sound."

P4 (attack): Time slowed down in an instant. My hearing was such that every noise sounded muffled. I knew I had to get to the toilet which was behind me. I could feel my body in slow motion during this turning phase and I could also hear my boss yelling an obscenity which was again listening to a tape at quarter speed. It actually sounded like that.

P17 (Accident - falling off a horse): The sound was muffled, I could see the other rider who was watching, but he was blurred.

P36 (Explosion): Sound was loudly silent if that makes sense.

Discussion - Explaining TEEs

Arstila (2012) has suggested that accident-related TEEs are related to increased levels of norepinephrine in the brain, related to the "fight or flight" response. He has stated that high levels of norepinephrine could account for certain phenomenological aspects of TEEs, such as more focused attention, increased speed and accuracy of responses (Grefkes et al., 2010) and improved clarity of thought (Berridge and Waterhouse, 2003).

However, there are many difficulties with this explanation. The most common theme of both studies reported above are positive affective states (in particular, calmness) which does not correspond to the fight or flight response or higher levels of epinephrine. The fight or flight response suggests anxiety and stress, both of which are strikingly absent from most of the reports in my two studies.

Another issue is that TEEs do not *just* occur in accidents and emergencies but - as the above findings show - may also occur in non-emergency situations such as sports, psychedelics, meditation and listening to music. With the exception of sport (which might be seen as an environment in which emergency situations are artificially created), none of these are situations in which one would expect to find high levels of norepinephrine. In fact, states of meditation (and other relaxed states such as listening to classical music) are usually experienced as states of stillness and inner peace, in stark contrast to a fight or flight response. This argues against a direct causal connection between high epinephrine levels and TEEs.

An alternative would be to suggest that accident-related TEEs and other types of TEEs are phenomenologically distinct experiences, with different causes. (I will discuss this possibility in more detail in the conclusion.)

The "Recollective" Theory

Stetson et al. (2007) have suggested that TEEs are due to the increased number of impressions and perceptions the mind absorbs in accident and emergency situations. This explanation could possibly hold true for meditative and psychedelic TEEs too, since they often feature intense and vivid perception, bringing increased information processing. However, Stetson et al. (2007) have argued that TEEs do not actually occur *in the moment* but are simply a recollective effect. As they have written, "time-slowing is a function of recollection, not perception: a richer encoding of memory may cause a salient event to appear, retrospectively, as though it lasted longer" (Stetson et al., 2007. p.1). In

other words, TEEs are an "illusion of remembering an emotionally salient event" (Stetson et al., 2007, p.1).

As evidence for this assertion, the authors describe an experiment in which participants made free fall jumps (for 31 meters) before landing in a net. They wore a hand-held device to measure visual perception, but there was no evidence that they were able to process for visual information than normal. (Specifically, they were unable to see numbers of the watches, only seeing a blur.) Despite this, the participants retrospectively over-estimated their own falls by 36%, compared to the falls of others.

However, there are some issues with this theory and the experiment that allegedly supports it. First of all, it is important to note that the free fall jumps of the participants did not constitute a *real* emergency. Real emergencies are unexpected and involve real danger. In fact, the sheer shock of their sudden unexpected occurrence may well be part of the reason for their powerful consciousness-shifting effect. In contrast, the participants in the above experiment were obviously fully aware in advance of the nature of activity, and aware that it did not involve real, life-threatening danger (since they had a safety net). The jumps were not dramatic or sudden either, since the participants had to undergo preparations, climb up to the tower and wait, while watching others make the jump before them (Arstila, 2012). The fact that the participants only over-estimated their falls by 36% (compared to the massive expansion of time reported by many of the participants of my studies) also suggests that they did not experience the type of fully-fledged altered state of consciousness associated with genuine accidents or emergencies. It is therefore problematic to apply the findings of this study to genuine unexpected, life-threatening accidents and emergencies.

As discussed earlier., there does appear to be a relationship between increased information processing and an expanded experience of time (James, 1890/1950; Ornstein, 1969; Taylor, 2007). In a related theory, Eagleman & Pariyadath (2009) argue that "the experience of duration is a signature of the amount of energy expended in representing a stimulus, i.e. the coding efficiency" (p.

1841). They suggest that novel stimuli are perceived as longer in duration, compared to stimuli when they are repeated.

However, most of the TEEs in the two studies described above appear to be of a different nature and intensity to the expansion of time produced by increased information processing (or increased energy expended in representing a stimulus). As noted above, increased information processing is typically associated with new or unfamiliar environments and experiences (for example, a trip to a foreign country, starting a new career or a new relationship) and also perhaps with meditative practices. However, as also noted above, such time-expansion tends to be relatively modest compared to the dramatic opening up of time that occurs in accidents and emergencies, when it sometimes seems as if seconds turn into minutes.

Certainly, the participants of the studies reported in this paper had a strong subjective sense that they were experiencing time expansion *in the moment* rather than as a recollection. As we have seen, one common theme of the studies was that TEEs enabled the participants to take preventive action in the face of danger, potential injury or death. Participants felt that they had more time than normal to contemplate the situation, consider their options and make decisions, and then to take action. Complex and detailed patterns of thought and complex sequences of actions were described as being carried out in periods of no more than a few seconds. One participant of the pilot study (P11) described a series of intricate thoughts that passed through her mind when she was knocked off her bicycle by a spray of water from a road watering truck, and then run over by a gravel truck:

I had a fairly long period where time was moving very slowly for me, and I had plenty of time for observations about it. Before the tires hit I was preparing myself for being a paraplegic and possibly having to navigate college in a wheelchair. I pictured myself in a wheelchair at the local university dances. (Becoming a paraplegic would be the only way I went to the local university instead of leaving state.) My folks were out of town, and had time to consider that was pretty typical - one of their children only went to the ER when they were out of town. I thought that for sure my mom

would fly up - at that point in time the only way my mom would be in the same room with my dad was if it was one of their children's hospital rooms. I had all that time to think of that and more in the less than a half second after I hit the ground and the tires hit me. (She reported that this period of time felt like about 40 seconds of normal time.

Such rapid thought processes are difficult to account for in terms of a recollective theory of time expansion. It seems reasonable to suggest that an exceptional experience such as an accident might produce powerful memories - thereby creating the impression of expanded time - but Stetson et al. (2007) do not suggest how an illusion of rapid thought processes could be related to recollection. As Arstila (2012) has pointed out, "the phenomenology of increased speed of thought does not conform with the memory account" (p.5).

It therefore seems reasonable to suggest that in most of TEEs of the two studies described above, we are dealing with something *more* than just increased information processing. There is certainly no doubt that TEEs *do* feature increased information processing, but it may well be that this is an effect rather than a cause. That is, an expanded sense of time may simply *make it possible* for a person to absorb many more impressions, without being responsible for the time expansion itself.

TEEs as an Adaptive Trait

Since many participants reported the sense that their TEE enabled them to take preventive action, it is worth considering the possibility that TEEs are a survival mechanism, a kind of evolutionary adaptive trait that our ancestors developed as a way of increasing their chances of survival in dangerous situations. Certainly, some participants of this study felt that the increased amount of time available to them helped to save them from serious injury or death, or helped them to save others. One participant of the pilot study (P2) who saved her children from a fire reported that, "I

think the only reason I was able to do this [save her children] was that I first experienced a great calmness and then that time seemed to stop." In another case from the pilot study, P9 described how, after falling off his motorcycle, "In that split second before impact time slowed enough for me to calmly pull my right leg up and over the seat and put it onto the left (top) side of the bike thus using the bike as a 'protective sled' underneath both legs."

One can easily imagine how this ability might have developed as an evolutionary adaptive trait. It would certainly have been beneficial for our early human ancestors - surrounded by wild animals and dangerous natural phenomena - to develop the ability to slow down their experience of time in emergency situations. However, one might argue that this would not explain why TEEs occur in *non*-emergency situations. We have seen TEEs in sports or games often feature the sense of having more time available to act and react, but competitive sports can be seen as a kind of re-creation of emergency or crisis situations, and so could also perhaps be explained in adaptive terms. But this would not apply to TEEs involving meditation or psychedelics.

The idea that TEEs are an adaptive also, incidentally, works against the notion that they are an illusory phenomenon produced by recollection (Stetson et al. (2007). It is difficult to discern any survival advantage in remembering accidents in more detail afterwards. As Arstila (2012) has written, "What might be the evolutionary value of such mechanism that alters our memories after the life-threatening situations over the mechanism that speeds our thoughts and actions during those situations?" (p.6).

Are TEEs 'Awakening' Experiences?

In previous studies (Taylor. 2012; Taylor & Egato-Szabo, 2017) the term "awakening experience" has been used to describe a higher state of consciousness in which awareness expands and intensifies. The term is analogous to spiritual experience (or mystical experience or transcendent experience) but the more secular term awakening is used to emphasise that the experience is frequently a

spontaneous one that occurs in the midst of everyday activities and situations. In other words, awakening experiences are not simply associated with spiritual traditions, or spiritual practices and paths.

In fact, studies suggest that awakening experiences are much more likely to have a secular rather than a traditionally spiritual origin. Characteristics of awakening experiences positive affective states, intensified perception, a sense of connection or oneness with other beings (including human beings, nature, the cosmos), a feeling of intense compassion and love and a lack of mental chatter (or inner stillness or quietness). At the most intense level, there may be a sense of transcending time and space and becoming one with a universal spiritual essence or "ground" of reality (Taylor, 2010, 2012; Taylor & Egato-Szabo, 2017). Again, it is important to note that these characteristics are very similar to those of mystical experiences (Hood, 1975; Marshall, 2005, 2014).

It is clear that most of the TEEs described above include some of the characteristics of awakening experiences. The calmness (and/or wellbeing) and the heightened awareness (or presence) of accident situations are reminiscent of reports of awakening experiences. At the same time, there are certain aspects of awakening experiences (such as intense compassion and a sense of connection or oneness) which were apparently absent from many of the TEEs in this study, particularly those related to accidents and some of those related to sports or games.

A smaller proportion of TEEs in this research conform more closely to awakening experiences. In the second study, most TEEs related to meditation or mindfulness appear to be equivalent to awakening experiences. This seems natural, since meditation is one of the most significant of awakening experiences, and time expansion (and even a sense of timelessness, at higher intensities of the experience) is sometimes a feature of awakening experiences. Such experiences could simply be categorized as awakening experiences that happen to include a quality of time expansion (or timelessness). For example, P1 described an powerful awakening experience featuring time expansion that occurred after a meditation: "I realized I was participating in that Awareness. Time stood still. The entire world seemed contained within me, even the 'edges' of the universe. I felt myself an ocean of existence in which all things were contained." P3 described a similar - although perhaps

not as intense - experience in which she 'suddenly felt very intense stillness, no breathing or awareness of body or surroundings. Time was standing still. Very peaceful'

Some of the participants' TEEs induced by accident and emergency situations could also be categorized as fully-fledged awakening experiences. For example. P15 described a TEE that occurred after he was stung in the mouth by wasps, which included the sense of connection/oneness (or transcending separateness) which is a prominent feature of awakening experiences. This participant reported that "I remember feeling that both her, myself and the wasp were not separate. Nothing was. Time was slow and but also did not exist." P11 described a car accident in which he "felt as though something else was in control of time, when it slowed down, not a bad feeling but a spiritual feeling." P53 reported a TEE that occurred while skiing which also appears to have been a fully-fledged awakening experience. As he reported, "Suddenly I was at one with skis, mountain, its slope, sky. No real sense of time yet the motion was taking place totally effortlessly." Similarly, P10 described an experience of timelessness while listening to classical music which was essentially an awakening experience. As she reported, "I heard the silence between the notes and it was breathtakingly beautiful…My mind is completely empty during experiences like that and I feel like there is no me."

These findings suggest that it is difficult to make a clear distinction between TEEs and awakening experiences, since they often overlap. However, my interpretation of the findings is to see most TEEs as a kind of partial or limited type of awakening experience. However, sometimes fully-fledged awakening experiences occur too. Perhaps it is appropriate to think in terms of two categories of experiences: time expansion experiences (which may feature characteristics of awakening experiences) and awakening experiences (which may include the quality of time expansion, or timelessness).

Conclusion: TEEs as an Altered State of Consciousness

The above discussion highlights one possible issue with the main study described in this paper. Perhaps it is not valid to discuss TEEs in general without separating them into different categories. It is possible that accident-related TEEs belong in a different category to other TEEs, and should be treated separately to them. This category would also possibly include TEEs related to sports and games, which often involve an artificial recreation of emergency situations. Certainly (while overlapping) the phenomenology of accident-related TEEs appears to be slightly different to the phenomenology of mystical experiences, NDEs or psychedelics experiences. Accidents and emergencies clearly have the capacity to bring about a shift into an altered state of consciousness, due to their sheer shock and intensity. But perhaps the altered state associated with them is phenomenologically distinct to other altered states associated with TEEs. (Above I argued against Arstila's, 2012, theory that accident-related TEEs are caused by high levels of norepinephrine in the brain is not applicable, pointing out that TEEs occur in "low arousal" states of meditation and relaxation. But if "high arousal" accident situations belong to a different category of TEEs, then this argument is not applicable.) Perhaps this is an issue which further phenomenological research can elucidate.

However, from any perspective, this study supports the idea that what we perceive as "normal" experience of time belongs to a specific type of "normal" consciousness. As Wittman (2018) has noted, our experience of time is closely bound up with our sense of self, and our state of consciousness. When an individual undergoes a shift into a different state of consciousness, due to unusual circumstances or triggers, then there is a shift into a different "timeworld" in which their experience of time expands dramatically, or even disappears. A different timeworld appears to lie beyond the boundaries of our normal self-system, and we gain access to it when our normal psychological structures and processes are altered sufficiently for our normal self-system to dissolve away.

Like the normal state of consciousness itself, our normal experience of time is neither objective or absolute. This study supports the notion that what we consider a *normal* state of consciousness is, as James suggested, is "but one special type of consciousness, whilst all about it, parted from it by the flimsiest of screens, there lie potential forms of consciousness entirely different"

(1985, p.388). Our normal state of consciousness is associated with a particular type of experience of time (essentially, a particular *speed* of time), which is produced by the psychological processes and structures of our normal self-system.

In particular, it may be that there are two main aspects of our normal self-system that produce our normal experience of time. The first is a strong sense of duality between the individual and the world, a sense of being enclosed within one's own mental space with the rest of the world "out there." In mystical experiences - and sometimes in psychedelic and near-death experiences - the dissolution of duality is associated with the transcendence of linear time, so it is feasible to suggest that a sense of duality is associated with the experience of linear time, with a strong sense of time flowing from the past to the present and into the future.

The second aspect of our normal self-system that may produce human beings' normal experience of time is the automatized nature of our normal perception, particular in the midst of familiar experiences and familiar environments. This results in a reduced amount of information-processing, which has the effect of speeding up our experience of time. The increasing familiarity that fills our lives with increasing age may be largely responsible for the sense that time speeds up as we get older (Taylor, 2007).

This perspective does not necessarily contradict the notion of TEEs as an adaptive trait. It may be that what we experience as normal consciousness has also developed because it was adaptive - that is, as an optimum mode of functioning in terms of dealing with the practicalities of day to day survival. (From a more nuanced perspective, in Taylor 2005, it is suggested that the strongly dualistic self-system of contemporary western cultures is a relatively late development, related to environmental conditions in central Asia and the Middle East several thousand years ago.) At the same time, it may be that our ancestors developed the ability to shift out of this normal consciousness into altered states of time expansion as a special response to dangerous life-threatening situations. In other words, both our normal consciousness and the ability to shift into a different time-world may be adaptive.

One more radical interpretation of the findings of the studies described above, however, might be to suggest that our normal experience of fast-flowing linear time is merely a psychological construct, and even illusory in nature. This allies with Kant's theory that time is not a fundamental quality of the world but a "category" of the mind that imposes order on our experience (Smith, 2003). There is a connection here with some theories and interpretations of physics, which question the existence of linear time. As Penrose (1999) has put it, "The way in which time is treated in physics is not essentially different from the way in as which *space* is treated … We just have a static-looking fixed 'space-time' in which the events of our universe are laid out!" (p.174). Like Kant, Penrose has suggested that a sense of linear time is created by the human mind to order our experience.

If the experience of fast-flowing linear time is partly an effect of a sense of duality, it may be that as the sense of duality becomes less pronounced - that is, as the self-system becomes more labile and less separate - time begins to slow down. (This would be equivalent to the TEEs related to accidents and emergencies.) At a certain point, duality may disappear altogether, when the self-system becomes so labile that there is no distinction between self and the world, as in mystical experiences, NDEs and some psychedelic experiences. At this point, any sense of linear time may disappear altogether. According to this theory, time is simply a construct of the boundaries of the normal self-system, and fades away as duality fades away, and disappears as duality disappears.

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Tables

Table 1

Triggers of Time Expansion Experiences

Trigger	Number of occurrences (from N=74)
Accident and emergencies (e.g. car accidents, falls, health emergencies, violent attacks)	40
Spiritual states practices (meditation, mindfulness, presence)	12
Psychedelics	7
Sports and games	7
Traumatic life events	3
Intense interpersonal contact	3
Listening to classical music	1
Out of body experience	1

Table 2

Summary of Main Themes

Theme (with Subordinate themes)	Number of occurrences (from N=74)
Positive affective states (calmness, detachment, lack of anxiety about danger, sense of well-being, spiritual feelings)	61

Alertness (heightened awareness, presence, clarity)	39
Extraordinary and dramatic nature of time expansion (seconds turning into minutes, sense of timelessness, or that time had stopped or disappeared)	36
Opportunity to take preventative action (rapid, detailed thinking; more time to make decisions and take action)	26
Quietness (muffled noise, reduced awareness of surroundings)	17