Mind-wandering in Aesthetic Experiences

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Abstract

Aesthetic Experiences are pleasurable phenomena of deep engagement with the sensory world, where one becomes highly captivated with an external object or event, often loosing awareness of self, time and environment in it. Mind-wandering means a detachment from the sensory world, where attention gets redirected onto the inside and moves across self-relevant thoughts and images. These phenomena are therefore highly polarized, suggestibly incompatible. This study primarily aimed to assess whether Mind-wandering occurs inside Aesthetic Experiences and to make a phenomenological account for it. By means of a diary study, participants self-reported upon their naturally occurring Aesthetic Experiences. Reports depicted Mind-wandering to be a common constituent of Aesthetic Experiences, to co-occur with decrements in absorption, and to display a distinct profile. Mind-wandering was reported as mostly positive, future-oriented, spontaneously generated and accompanied by higher meta-awareness. Participants also described their wandering thoughts and images to be connected to the themes of their Aesthetic Experience. These findings together depict Aesthetic Experiences to be constituted by brief periods of internal orientation onto the self, and Mind-wandering to not be fully stimulus-independent, suggesting both phenomena to be better modelled more expansively. The adaption of an allocentric-egocentric framing spectrum might also be helpful in understanding the relation between Aesthetic Experience and Mind-wandering.

Keywords: Mind wandering, aesthetic experience, absorption, default-mode network, spatial reference frames

Mind-wandering in Aesthetic Experiences

As humans, we find ourselves inside a world full of sensory stimuli. Our interaction with this world differs constantly; sometimes we are deeply engaged with it, while at others, we are detached from it. Within this spectrum of connection and disconnection from our surroundings, Aesthetic Experiences (AE) stand out as a prime example for profound engagement with the environment. During AEs, humans become deeply amazed by the sensory world and absorbed into it, often losing their sense of time and self in amazement of an object or event (Markovic, 2012). Mind-wandering (MW) on the other hand exemplifies the other end of this spectrum, a falling out of the sensory world, where attention is relocated onto the inside and the mind starts to wander across self-referential thoughts and images (Smallwood & Schooler, 2015). These phenomena are therefore highly polarized, reflecting two extremes of external and internal processing, making them seemingly incompatible.

Where both converge is their heterogeneity. While sensory input is rather robust, the cognitions evaluating it are fragile, making the aesthetic space essentially infinite. Likewise, the paths of a wandering mind can lead both upwards and downwards, able to entail adaptive and maladaptive processes, such as future-planning or the cycles of rumination (Irving et al., 2022; Da Silva et al., 2019). Somewhat surprisingly, in their heterogeneity is also where potential lies for their practical convergence. Both phenomena are component-streams (Chatterjee & Vartanian, 2014; Smallwood & Schooler, 2016), which means that they differ in their composition by their constituents through time, and therefore suggestibly also in living up to these polarized conceptualizations. Further, regular oscillations between external and internal processing modes are simply an integral part of the brain's functioning (Mills et al., 2018; Honey et al., 2017) and AEs might just be constituted by MW during the waves of a component-stream.

Studying whether AEs are constituted by MW likely holds double benefits. It challenges AE as a phenomenon of constant sustained attention with the external, while simultaneously seeking to identify an interactor of a peak phenomenon of human experience. Also, by describing how MW occurs inside AE, it makes an account for its phenomenology and yields about potential context-dependencies.

Aesthetic experience

AEs can occur everywhere, during every-day activities such as dining, short-lived interactions, walks at night, writing a thesis, or within more conventionally aesthetic settings, such as viewing artwork or being narratively transported while listening to music or reading. Irrespective of their idiosyncrasy, AEs converge in differentiating themselves from ordinary experiences by their temporal and phenomenological uniqueness (Markovic, 2012). They are multileveled, meaning-attributing, and intense relations between individuals and their environment, constituted by the interaction of a sensory-motor- (SMC), an affective-evaluative- (AEC) and a knowledge-meaning component (KMC) (Shusterman, 1997; Chatterjee & Vartanian, 2014; Markovic 2012; Pearce et al., 2016). AEs can thereby centre around any object, as long their multi-relation stretches across this aesthetic triad (Chatterjee & Vartanian, 2014) and their experiencer becomes strongly focussed on and fascinated with the object or event (Markovic, 2012). While feedbacking across these components is likely similarly individual and intricate as their temporal weight and dynamism (Chatterjee & Vartanian, 2014; Augustin & Leder, 2006), a crucial mechanism for AEs is the relationship between perceptual-cognitive and emotional processes (Markovic, 2012).

Sensory-motor

The SMC of AE encapsulates their perceptive and attentive aspect, including basic sensory processing, recognition, mirror neuron activity, arousal and attention (Chatterjee & Vartanian, 2014). While models of aesthetic processing begin with stimulus input and

perceptual analysis (Chatterjee 2003; Leder et al., 2004), the involvement of these stages is unfinished irrespective of later feedbacking, simply by encompassing continuous processes such as visual tuning (Carr & Bacharach, 1976). Still, the usefulness of separating AE broadly into earlier perceptual and later semantic stages is evidenced (Markovic, 2012). The importance of mirror neuron systems for narrative appraisal and art perception has been recognized (Gallese & Freedberg, 2007; Piechowski-Jóźwiak et al., 2017), allowing the embodied simulation of perceived properties, such as the gestures, movements, intentions and emotions of depicted characters in paintings.

As aforementioned, AEs are states of intense attentional engagement and high vigilance, in which individuals become deeply captivated by and fascinated with an object, often losing their self, temporal and environmental awareness (Markovic, 2012). The concept of absorption likely reflects these characteristics jointly well, defined as "an extreme involvement or preoccupation with one object, idea, or pursuit, with inattention to other aspects of the environment." (APA, 2018). This line of thought is further supported by absorption predicting and constituting a variety of AEs, such as peak and mystical experiences, flow, awe and the sublime (Markovic, 2021; Luhrmann et al., 2021; Ellis et al., 1995; Van Elk et al., 2016; Kujipers et al., 2021).

Emotional-valuation

The EMC encapsulates all emotions occurring within the AE, with an emphasis on their irreducibility to mere positive valence. The hedonic tone of AE stretches continuously from negative to positive (Silvia 2009, 2012), and following appraisal-theory, these emotions are not direct effects of the experienced, but of its subjective evaluation. Emotions underly unique appraisal structures, reflecting the alignment or misalignment of perceived properties (e.g. resonance of perceptual characteristics, attributed meanings, drawn associations) and aspects of the self (e.g. one's preferences, values, goals). (Silvia, 2009, 2012). Positive

emotions therefore reflect the predominance of congruences, while mixed emotions are underlaid by a balance of matchings and disparities, and negative emotions are the consequences of predominant misalignment.

Regardless of their emotional design, AEs are defined as overall pleasurable experiences. This seems contradictory with the general displeasure of negative valence but can be accounted for by the ways in which negative and mixed emotions are utilized inside AEs (Silvia, 2009). The distancing-embracing model depicts such processing, where such emotions are allowed to unfold while keeping a degree of psychological distance to them, and overall hedonic expectations of the experience are simultaneously regulated. These emotions are then integrated in a utilitarian manner for their attentional and arousing capacities, heightening the experiences' emotionality, intensity and interest, and thereby reward (Menninghaus et al., 2017). While this seems inconsistent with absorption's general principle of closing psychological distance to the object at hand (Tellegen & Atkinson, 1974), absorption into narratives is suggested not to be total, but to co-occur with a degree of awareness about their construction (Hakemulder, 2017).

Knowledge-meaning

The KMC of AEs encompasses all symbolic relations and meanings found inside the multi-relation, featuring any associations drawn to the self and other memory-driven influences constituting the experience, such as relating social touching with emotional bonds (Capelli, 2022) or understanding about the authenticity and intentionality of art (Newman et al., 2019; Jucker et al., 2014). Most processing models of aesthetic response sequence their meaning-making and judgmental component as their later or final component, yet, as with the triad's other constitutes, its real-time involvement stretches across the entirety of an AE. Top-down processing for example is evident early on during stimuli input, as in the differential scanning of paintings for nature vs. human-content (Massaro et al., 2012).

Mind-wandering

MW can be generally defined as a type of spontaneous thought, characterised by the drifting away from attending to the outer world and its events, and relocation of attention inwards onto self-relevant themes unrelated to the environment (Mason et al., 2007). Such independent neural processing makes up much of the brain's default functioning (Smallwood & Schooler, 2015), and MW as one of its kinds alone occupies an estimated 30-50% of daily waking life alone (Kane, 2007). As suggested by its temporal expansiveness, MW is far from a homogeneous phenomenon (Seli et al., 2018) and can surround rather expansive and beneficial processes, such as goal reminding, future-planning or simulation and creative incubation, as well as dysfunctional and even clinically relevant ones, such as cognitive reactivity, rumination or affective dysfunction (Marchetti et al., 2016; Smallwood & Baracaia, 2003; Baird et al., 2012). Since MW is likely best understood from a family-resemblances perspective (Seli et al., 2018), where category members overlap in their features but vary in their precise make-up, MW will be described and measured along many possible, but not definite constituents.

Generation of MW

The occurrence of MW is theorized to depend on low constraints on individual mental states and transitions between them. Constraints are suggested to either depend on cognitive control, meaning when attention is shifted deliberately, or on automaticity, when attention is captured spontaneously (Giambra, 1995; Christoff et al., 2016). MW is able to generated by both types and mapped within spontaneous thought types as more deliberately constrained than daydreaming, while being less automaticity-driven than involuntary autobiographical memories (Marchetti et al., 2016).

Meta-awareness

The relation between MW and its meta-awareness is temporally dynamic and their junctions can be understood as *ignition points* (Smallwood, 2013). Conscious processing of MW and its temporal tracking thereby only occur during their pairing, when cognitive resources are spent on monitoring the ongoing state. Greater MA might also counter its potential decremental effects (McVay et al., 2009; Deng and Li, 2012; Maleeh & Konjedi, 2022), possibly by enhancing cognitive control over unwanted episodes (Brandmeyer et al., 2020).

Perceptual decoupling

Perceptual decoupling, which refers to the generation of a processing bias for internal over external inputs, has been named as both a descriptor and cause of MW (Cohen et al., 2013), and experimental tracking shows the reduced responding to sensory inputs during MW's falling inward (Bruckmaier et al., 2023). While perceptual decoupling is often conceptualised as all-or-none, defined as the precise moment of disengaging from processing external stimuli (Goncalves et al., 2020), it likely accompanies MW more dynamically than its name suggests. MW is a component-stream (Smallwood, 2013; Smallwood & Schooler, 2015) with constituents varying in their cognitive load through time, and therefore suggestibly also their impedance on environmental engagement (Leszczynski et al., 2017).

Temporality, content & valence

While MW does have a notable negative and clinical connotation (Chaieb et al., 2022), its general tendencies are those of future-orientation, autobiographical planning (Baird et al., 2011) and a bias for positive content (Spronken et al., 2016). Regarding its characteristics in AEs, prior research suggests MW to potentially align with the nature of the AE they are embedded in. Listening to either heroic or sad music respectively occurred with more positive/motivating and depressive/demotivating MW (Koelsch et al., 2019), and the valence of emotions evoked during private music-listening significantly correlated with the

valence of MW (Taruffi, 2021).

Frequency & duration

The frequency of MW has been shown to increase with ongoing task performance (Zanesco et al., 2023; Chaib & Fell, 2024), and also during sustained attention tasks (Cuadra, 2020), which likely mimic best the attentional characteristics of AE. The general duration of MW episodes seems to centre around seconds, but ranges up to several minutes (Voss et al., 2018; Henriquez et al., 2016; Bastian & Sackur, 2013). While the aforementioned estimates of daily MW ~30-50% are generally accepted across literature, these numbers have been shown to depend on treating environmental engagement/disengagement and internal/external experience as strictly dichotomous concepts (Seli et al., 2018). This approach has been challenged before as unable to account for the true dynamics of MW and providing less binary response options yielded much different estimates in self-reports (Seli et al., 2018).

Suggestions of proximity

AEs and MW are highly opposed in their definitions. AEs mean being captivated by and deeply engaged with the sensory world, while MW means to focus inward, detached from perception and unrelated in its contents to the environment. Both are therefore antagonistic to each other, but also component-streams with varying cognitive load through time. While absorption is originally defined as total (Tellegen & Atkinson, 1974), its fluctuations can be observed in motor pattern variations, such as oculometry changes (Lange et al., 2017), and the perceptual decoupling of MW likely varies in its disconnection from the environment through time. MW has also been previously challenged for its binary depiction as stimulus-independent, and might be more expansive than previously thought.

Hypotheses and aims

The present study aims to test three hypotheses. First, despite their polarized conceptions and seeming incompatibility, it predicts that (1) MW will significantly occur

inside AEs. Secondly, (2) AEs will be generally characterized by high absorption (reflecting the appropriateness of using the concept as a reflection for its defining characteristics), but the overall absorption of AEs constituted by MW will be significantly lower than that of AEs absent of MW. This reasoning stems from resource-theories of MW (Kopp et al., 2016), which describe it as a function of external cognitive load, occurring more often when task demand is decreased and resources are freed. Additionally, previous findings depict a general inverse relationship between absorption and MW (Sullivan, 2020). Thirdly, based on previous literature suggesting MW to align with the setting its embedded in, findings are hypothesized (3) to depict a degree of connection between AEs and their MW. This study therefore challenges hardline adherence to the conceptions of both phenomena, evaluating AE for introspective periods and MW for a degree of environmental relation, while simultaneously making a phenomenological account for how minds wander inside AE.

Methods

The present study was conducted as part of the broader D.E.A.R. (Diary of Empirical Aesthetic Research) Study, which aims to more broadly enhance understanding about AEs. The D.E.A.R. Study was a wide experience-sampling study, asking participants to report on their naturally occurring AEs by making diary entries. Participation criteria were a minimum age of 16 years and fluency in either English, Dutch or German. Data collection began on November 9th, 2023 and was cut for analysis on December 10, 2023. Based on a checklist developed by the EC-BSS of the University of Groningen, the D.E.A.R. Study was exempt from full ethical review.

Participants

Throughout its run, the D.E.A.R. study recruited a total of 236 participants, of which 61 met final inclusion criteria, being the completion of at least two entries, as well as its pre- and post-measures. Three AE entries were removed during data processing, two due to being copies and one due to recording errors. The sample therefore averages 3.7 entries per person (*SD* = 1.08), accumulating a total 226 individual entries, or reported upon AEs. Sample demographics recorded are displayed below in Table 1, with zero-count categories excluded except for 'intersex'.

Table 1

Sample demographics

Participant n = 61		Frequency	Percent (%)
Age in years	Under 18	2	91.8
	18-24	56	3.3
	35-44	2	1.6
	55-64	1	3.3
Gender	Female	52	85.2
	Male	8	13.1
	Non-binary	1	1.6
Sex assigned at birth	Female	52	85.2
	Male	9	14.8
	Intersex	0	
Survey language chosen	English	35	57.4
	Dutch	21	34.4
	German	5	8.2
Being a first-year student	Yes	60	98.4
	No	1	0.6

Having moved to a new city within the last year	Yes	41	67.2
	No	20	32.8

Research design and Procedure

The D.E.A.R. Study's online self-report survey was designed collaboratively to assess a variety of aspects of participants' AEs and their personal attributes in relation to these experiences. The survey was made available to participants in an app and a website format designed using Qualtrics (https://www.qualtrics.com/). This longitudinal design allowed participants to freely choose when to make an entry, yet they were prompted to report recently on AEs after their occurrence. Given E-mail addresses were used as temporary identifiers for linking entries with each other and to send weekly reminders to continue engagement. All links to participants' identity were deleted after processing data and before its analysis. The study's questionnaire was set up in three phases, which are described hereafter.

1. Pre-questionnaire. The pre-questionnaire included an information form, a short definition of AE and the gathering of informed consent, demographics and self-perceptions about the general occurrence rate of AEs in one's life and the importance and memorability of those experiences. Additionally, instruments assessed recent stress levels, current mood, art knowledge and interest, and individual differences in self-focused attention and private self-consciousness.

2. Diary entries. Upon completion of the study's pre-measures, the diary entry phase was made accessible. Starting an entry was accompanied with a redisplay of the short definition

of AE, and participants where then evaluated on various measures surrounding the AE they chose to report upon. This included being asked about the time of its occurrence, whether its intensity varied or was constant, which stimulus was perceived to cause it, and whether the AE was featured by alternations in time perception. Additionally, specific items assessed the appreciation, intensity and meaningfulness participants attributed their experience, and instruments were used to assess emotions evoked by the AE, its mind-wandering, immersion and flow. Participants were also asked to describe the meaning of their experience using their own words, as per think-aloud protocols by Tenbrink (2015). The ordering of these measures was the same for each entry.

3. Post-questionnaire. If participants indicated their present entry to also be their last one, they were directed to the study's post-measures, which then re-assessed recent stress levels and the capacity for mental imagery.

Measures

A full index of all measures used by the D.E.A.R. Study can be found in the appendix A, in Table 2. This analysis assesses the emotions, fluency, absorption, meaning, time perception, intensity trajectory, appreciation, duration and stimuli of reported AEs in relation to its MW. To this end, instruments used are the Geneva Emotion Wheel 2.0, subscales of the Flow-Short Scale, an abridged version of the Recalled Aesthetic Experiences' survey and the self-constructed questionnaire for MW.

Absorption subscales of the Flow-Short Scale (FSS)

The Flow-Short scale is a 16-item inventory, which measures state flow as a component through 10 of its items. The FSS is comprised by two subscales reflecting the phenomena's constituents, being fluency (smooth action pursuit) and absorption (sustained attention and immersion). These subscales record individual Cronbach alpha values of >.80

(Rheinberg et al., 2003). The FSS has been used to reliably capture flow experiences across various (Engeser & Rheinberg, 2008), showing converging validity with other prominent flow measures (Laakasuo et al., 2022), speaking for its validity in capturing the subcomponent of absorption.

Geneva Emotion Wheel (GEW 2.0)

The GEW2.0 is a colorized circle divided in quadrants, which maps 40 equally weighted emotions into 20 emotion families around its circumference, and organizes them along axes of unpleasantness/pleasantness and high/low control. Choosing an emotion requires radial placement, with more inner positioning reflecting weaker and more outer positioning reflecting stronger intensity. The circles' centre provides the alternative options 'none' and 'other', reflecting the absence of emotions and allowing individual description. Participants could make up to two indications on the wheel to describe emotions constituting their AE. The GEW2.0 is theoretically built on appraisal-theory (Coyne et al., 2020), has been previously used for emotion assessment across various contexts, and preferred over alternative measures by participants, described as clearly understandable and useful for its differentiability and choice (Sacharin et al., 2012).

Mind-Wandering

Items assessing the valence, meta-awareness and intentionality of MW were adopted from Taruffi (2021), while items capturing its frequency, duration, temporality and content-proximity were adopted from Deil et al. (2022), along with the shortened definition of MW displayed to participants, which got redisplayed during each entry. Adaption of items from both studies is supported by their design for measuring MW via self-report and previous use in relating settings, during private music-listening and listening to contemporary live music (Taruffi, 2021; Deil et al., 2022). The item assessing perceptual decoupling was adopted from the Mind wandering inventory (Gonçalves et al., 2022) and chosen for its highest factor

loading (.85) on the concept. Additionally, experts ranked it as highly representative for the concept (Gonçalves et al., 2022). The composed questionnaire is further described in the appendix, in Table 3.

Power

Criteria for both qualitative and quantitative analyses are met by the sample. An a priori power analysis was conducted using G* Power version 3.1.9.7 (Faul et al., 2007) to determine the minimum sample size needed to test the study hypotheses. Results indicated the required sample size to achieve 80% power for detecting a medium effect, at a significance criterion of $\alpha = .05$, to be N=82 for correlational analysis and N=64 for t-testing. The present sample therefore meet these requirements.

Analysis

Despite measures being Likert items or scales, an intervalist stance toward the data is made. Underlying constructs are assumed to be continuous in nature, equidistance between their levels can be assumed, scales yield composite scores and items are anchored only at extremes, making them numeric rating scales treatable as continuous (Harpe, 2015). The validity of parametric testing on ordinal data has been shown even under considerable assumption violation (Glass, Peckham & Sanders, 1972; Hsu & Feldt, 1969, Norman, 2010), and comparison of parametric and non-parametric testing on the same data has repeatedly yielded highly correlated and converging results (Norman, 2010; Mircioiu & Atkinson, 2017; Harpe, 2015; Derreck & White, 2017). Additionally, for the sake of this pilot study, entries by participants were treated as independent units, a decision supported by rather low intraclass corelation. The standard for what should be considered a significant occurrence of MW will be set to 15% of all experiences. Correlational analysis will be applied to assess the relation or independence of AE and MW items, and ANOVAs will be applied to assess

differences for levels of MW temporality and constraint across all variables. T-testing will be used to compare AEs featuring MW to those that occurred without it for differences in absorption and on all other variables. Effect sizes for measures of association and central tendency will be classified according to Cohen's recommendations (Cohen, 1998).

Results

Data polishing led to the exclusion of particular entries from specific calculations. Eight entries were excluded from GEW calculations because their emotion indicators were placed outside the wheel and deemed invalid, while another eight were excluded for calculations using the differential intensity item, since errors lead to the recording of multiple instead of exclusive answers. Additionally, eight AE duration scores were changed based on their severe incoherence with open-question reports. Boxplots were used for scanning outliers across variables, with no problematic scores detected except for the top three values of AE duration, which were trimmed because of severe isolation. Normality has been assessed for all variables and re-assessed for all tested DV groups based on standards for skewness and kurtosis of -2/+2 and -7+7 (Hair et al., 2010). Levene's test statistics were used to decide upon t-tests for equal or unequal variances. Significance was assessed based on alpha of .05, and adjusted using Bonferroni's correction for repeated comparisons.

Characteristics of Aesthetic Experiences

The results presented in this section depict the general characteristics of the sampled AEs. Overall, AEs were found to be predominantly positive experiences, with mean scores for meaningfulness, appreciation exceeding neutral midpoints of Likert items, and emotional valence laying in the wheel's upper positively valenced half. AEs were reported as rather intense experiences, aligning with high scores for emotional intensity. A slight majority reported their AEs to be of constant intensity (56.2%), while the intensity of AEs with

varying intensity was indicated to be predominantly strongest at the beginning of the experience. Means for the FSS subscales depicted AEs to be rather fluent phenomena, which were also characterized by high absorption. The median duration for AEs was 30 minutes, yet duration varied widely, spanning from a single minute onto several hours (*minimum* = 1, *maximum* = 420), with a mean absolute deviation of 63.02 minutes. A majority of AEs were reported to feature alternated time perception (64.6%), with specifier options showing rather equal counts for time being perceived faster, slower or having lost its sense. Descriptive statistics for the aforementioned variables are displayed below, in Table 4, while frequency counts for the time perception and intensity trajectory item are displayed in the appendix, in Tables 5 and 6.

Table 4

Descriptive statistics for AE items

	N	Minimum	Maximum	Mean	St. Deviation
Appreciation	222	1	7	5.78	1.25
Meaning	226	1	7	5.04	1.46
Intensity	226	1	7	4.94	1.47
GEW valence	218	-.67	.99	.544	.35
GEW intensity	218	-.21	.93	.65	.16
GEW arousal	218	-.86	.91	.10	.41
FSS absorption	226	9	28	20.97	3.90
FSS fluency	226	6	42	30.70	5.19

Note. Neutral midpoint for appreciation, meaning and intensity lies at Likert-level four, for GEW measures at zero, for FSS absorption at fourteen and for FSS fluency at twenty-one.

Stimuli perceived as having caused AEs were predominantly indicated as belonging to nature (36.7%), followed by rather groupable counts for social situations, music, human-made environments, and visual art (total 52.6%). A remaining 10.6% of stimuli were

indicated as belonging to ‘Other’, ‘Culinary’, ‘Literature’ and ‘Other media’. Frequency counts for these stimuli categories are displayed below, in table 7.

Table 7

Stimuli categories perceived to having caused the AE

N = 226	Frequency	Percent (%)
Nature	83	36.7
Social situation	38	16.8
Music	29	12.8
Human-made environment	29	12.8
Visual art	23	10.2
Other	10	4.4
Culinary	6	2.7
Literature	5	2.2
Other media	3	1.3

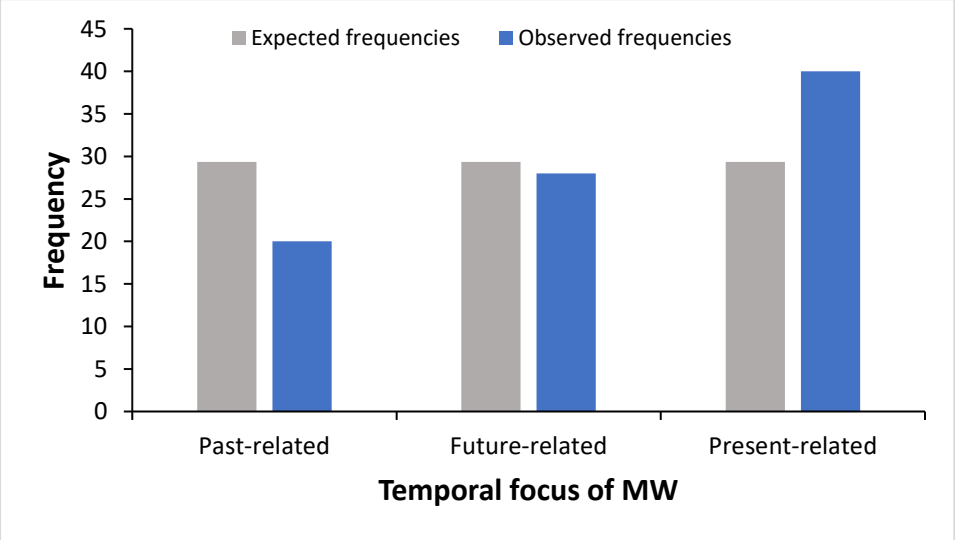
The time perception and intensity trajectory item were binarily recoded to compare groups of AEs for different outcomes. This yielded AEs with alternated time perception to be significantly higher in scores for appreciation, intensity, duration, emotional intensity, absorption, fluency and meaning. Comparisons of AEs with constant intensity to those with changing intensity are listed in Table 8, comparisons the groups of AEs with altered time perception and unaltered time perception are listed in Table 9, which can be both found in the appendix.

Mind-wandering

Out of the 226 AEs reported upon included in data analysis, 88 of them were indicated as having featured MW (38.9%). The temporal focus of MW laid predominantly on the present, followed by loci on future and past, and these differences in counts were found significant using Chi-square testing against chance probability ($x^2(2) = 6.909$, $p > .032$.). MW was also reported as having occurred mostly spontaneously, followed by counts for being intentionally generated and unawareness about its generation mode. These count differences were also significant under the same testing standard ($x^2(2) = 42.977$, $p < .001$). Figures depicting expected versus observed frequency counts for levels of MW temporality are displayed below in Figure 1, while counts for levels of constraint are displayed below in Figure 2.

Figure 1

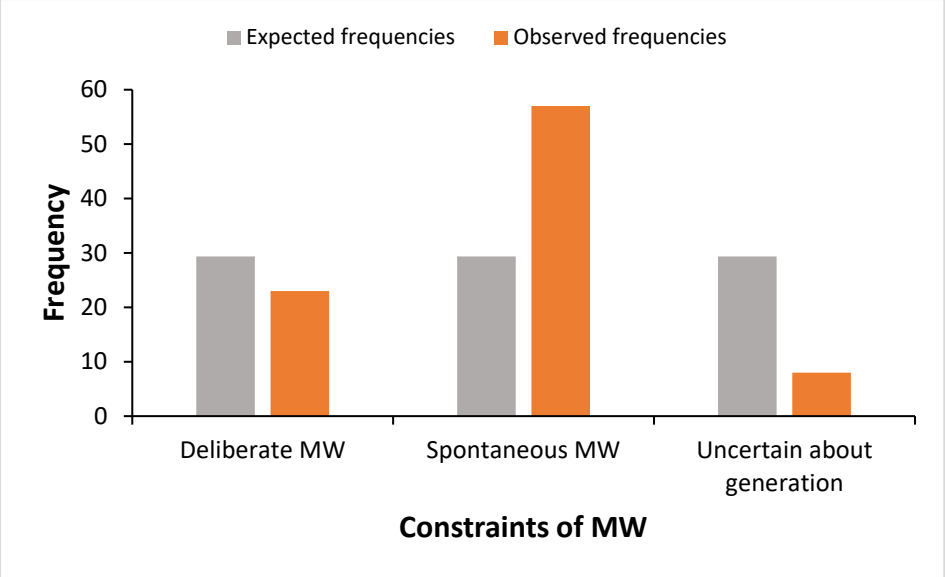
Expected versus observed frequencies for levels of MW temporal focus under equal chance



Note. Past-related count = 20; Future-related count =v28, Present-related count =40.

Figure 2

Expected versus observed frequencies for levels of MW constraint under equal chance



Note. Deliberate MW count = 23; Spontaneous MW count =57; Uncertain count = 8.

Assessing mean scores of MW Likert items relative to their level four midpoints depicted MW as having occurred moderately frequent, with episodes ranging from seconds up to several minutes. The valence of MW was overall positive and participants indicated its contents to be rather connected than disconnected to those of the AE. MW was predominantly paired with meta-awareness and accompanied by moderate decoupling from perception. The frequency and duration of MW correlated strongly, and both also correlated individually and moderately with perceptual decoupling. Additionally, deliberately generated MW yielded significantly higher MW frequency scores than spontaneously generated MW ($t(78) = 2.72$, $p = .008$). Descriptive statistics for MW Likert items are displayed along their intercorrelation matrix below, in table 10.

Table 10

Descriptive statistics for MW items and their intercorrelation matrix

Variable	*n*	*M*	*SD*	*Min*	*Max*	1	2	3	4	5	6
1. Frequency	88	4.08	1.60	1	7	1					
2. Duration	88	3.93	1.53	1	7	.50**	1				
3. Valence	88	5.48	1.39	1	7	-.08	-.17	1			
4. Meta-awareness	88	4.60	1.45	2	7	-.08	.06	.17	1		
5. Perceptual decoupling	88	3.88	1.69	1	7	.34**	.27*	.006	-.04	1	
6. Content proximity	88	4.59	1.60	1	7	.12	.16	.04	.21	-.002	1

Note. *p<.05. **p<.01.

Analysis between AE and MW items

MW meta-awareness scores correlated slightly with perceived appreciation, emotional arousal and absorption, and moderately with perceived meaning and intensity of the AE. The valence of MW correlated slightly with AE meaning and emotional arousal, moderately with fluency of the experience, and strongly with its emotional valence and absorption. The duration of MW also correlated moderately and negatively with AE's emotional valence and slightly with emotional arousal. Content proximity scores also correlated slightly with AE meaning. A full correlation matrix is displayed on the next page, in Table 11. Additionally, t-testing showed past-oriented MW to have significantly higher emotional arousal scores than future-oriented MW ($t(45) = 3.90$, $p<.001$) and AEs with constant intensity to yield significantly longer MW episodes than AEs of varying intensity ($t(81) = 2.395$, $p = .0019$).

Table 11

Correlation matrix for MW and AE components

MW/AE	Appreciation	Meaning	Intensity	Duration	Emotional valence	Emotional intensity	Emotional arousal	Fluency	Absorption
Frequency	-.073	-.111	-.022	-.130	-.129	-.199	-.094	.083	-.06
Duration	.197	-.042	.001	.124	-.317*	-.098	-.076**	-.002	-.14
Valence	.095	.266*	.089	.168	.537**	.261*	.272*	.413**	.567**
Meta-awareness	.284*	.306**	.325**	.124	-.018	.294**	.194	.156	.256*
Perceptual decoupling	-.036	.058	-.073	.074	.027	-.017	.053	.111	.054
Content proximity	.107	.233*	.138	-.017	-.190	.092	.001	.166	-.003

Note. *p<.05. **p<.01.

Intercorrelation differences for AE items between AEs with and without MW

Lastly, AEs featuring MW were compared to those without MW, which yielded a variety of differences in correlations between the two groups. While appreciation was linked strongly to emotional intensity and fluency of the experience in AEs without MW, their correlations were insignificant in AEs constituted by MW. Similarly, meaning correlated slightly with the duration and emotional valence of AEs for those without MW, but no evidence was found for their relation inside AEs constituted by MW. On the other hand, fluency and intensity scores of the AE were suggested to be independent from each other inside AEs without MW, but correlated moderately inside AEs featuring MW. The same pattern was found for the slight association of absorption to duration and fluency, which only existed inside AEs featuring MW. Additionally, a variety of correlations between AE items were significant in both groups but differed in their effect size. For these pairs of correlations, z-scores were calculated to assess the significance of their disparity. Only one of their effect sizes differed significantly, being the higher correlation of intensity and meaning in AEs without MW (r_{diff} = .219, z = -.21, p = .04). Both groups were then compared for their mean outcomes on AE items. All mean differences on AE items were found insignificant, except for the higher absorption outcomes for AEs without MW ($t(224)$ = -.3.918, $p < .001$). Both correlation matrixes for the split groups are displayed below in Tables 12 and 13, while table 14 for all conducted t-tests can be found in the appendix.

Table 12

Descriptive statistics and correlation matrix for AE items of the AEs with MW group

Variable	*n*	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Appreciation	86	5.93	1.14	-								
2. Meaning	88	5.01	1.43	.56**	-							
3. Intensity	88	5.03	1.36	.57**	.38**	-						
4. Duration	87	71.5	81.75	.28**	.23	.20	-					
5. Emotional valence	87	.53	.36	.09	.15	.15	.14	-				
6. Emotional intensity	87	.64	.15	.42**	.36**	.43**	.21	.41**	-			
7. Emotional arousal	87	.06	.42	.06	.18	.08	.25*	.24*	.29**	-		
8. Fluency	88	31.40	4.87	.05	.21	.19	.03	.37**	.21	.26*	-	
9. Absorption	88	19.74	3.82	.60**	.33**	.32**	.16	.52**	.30*	.37**	.65**	-

Note. *p<.05. **p<.01

Table 13

Descriptive statistics and correlation matrix for AE items of the AEs without MW group

Variable	*n*	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Appreciation	136	5.68	1.32	-								
2. Meaning	138	5.05	1.48	.64**	-							
3. Intensity	138	4.88	1.53	.45**	.60**	-						
4. Duration	136	82.33	95.74	.24**	.23**	.16	-					
5. Emotional valence	131	.55	.35	.52**	.39**	.14	.14	-				
6. Emotional intensity	131	.64	.17	.30**	.31**	.20*	.20*	.48**	-			
7. Emotional arousal	131	.14	.40	-.12	-.15	-.17	.03	.14	.22**	-		
8. Fluency	138	30.25	5.36	.35**	.35**	.33**	.18*	.41**	.13	.09	-	
9. Absorption	138	21.80	3.80	.49**	.39**	.33**	.24**	.42**	.24**	.19*	.57**	-

Note. $^{*}p < .05$. $^{**}p < .01$.

Discussion

The present study primarily assessed whether AEs, phenomena of strong captivation by the sensory world, are constituted by periods of MW, introspective states defined by a falling out of perception. This study tested three specific hypotheses, being that (1) MW will significantly occur inside AEs despite their opposing natures, (2) that AEs constituted by MW will yield significantly lower overall absorption levels due to both processes drawing on shared attentional resources (3) and that findings will depict a degree of relation between the phenomena, replicating previous findings and further challenging MW as fully insulated from the environment. Through testing these hypotheses both phenomena were challenged in the appropriateness of hardline conceptions, evaluating evidence for more expansive modelling.

Hypothesis 1

MW occurred extensively within the present sample, namely in around two-fifths of all AEs (38.9%). It therefore almost quadrupled the previously set standard for what should be considered significant, confirming (1). This would have not been possible if AEs were solely states of uninterrupted and intense attentional engagement with the external object or event, evidencing periods of switching into more internal processing.

Hypothesis 2

As an expected extension of this finding, AEs constituted by MW displayed a significantly lower overall absorption gradient, confirming (2). This aligns with the resource-hypothesis of MW (Smallwood & Schooler, 2006), which depicts its generation to be dependent on decreased external cognitive load, freeing space for the unfolding of more intrinsic neural processing of the brain. It further aligns with the previous finding of an inverse relationship between absorption and MW. Levels of absorption also correlated with

the duration of AEs, but only for those which occurred without MW, suggesting that MW had an interrupting effect on the cumulation and trajectory of absorption.

Hypothesis 3

The valence of emotions generated inside the AE correlated with the valence of MW, thereby replicating their previous association during private music-listening (Taruffi, 2021). Further, most participants reported their MW to be connected rather than disconnected to the themes of their AE, clearly suggesting MW to extend beyond simple dichotomies of stimulus-independence. The valence of MW also correlated with meaning attributed to the AE, and since meaning did not correlate with the valence of emotions of the AE, this might depict another bridge the phenomena. These results together depict the confirmation of (3), showing that the wandering minds of AEs were not fully insulated from the broader experience, but to some extent connected.

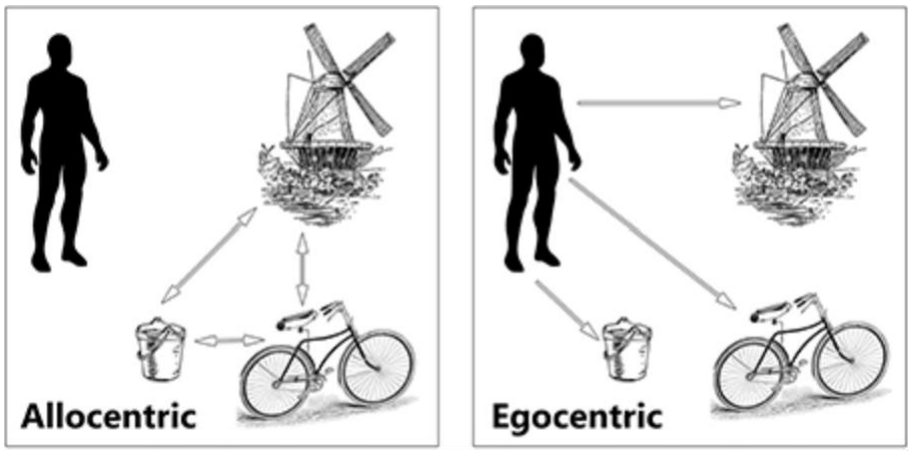
Phenomenology of MW inside AE

MW was found to be mostly positive in its contents and themes, thereby aligning with its general trend in the population (Spronken et al., 2016). Its episodes were predominantly spontaneously generated, and since such unintentional MW is rather linked to its maladaptive side (Carriere et al., 2013), the currently recorded predominance of positive but spontaneous generations suggests a context-dependency. The temporal focus of MW laid predominantly on the present, followed by loci on the past and future, therefore replicating the pattern found for its temporal directions while attending contemporary live-music (Taruffi, 2021). This contrasts with MW's general tendency to be future-oriented (Baird et al., 2011), and might therefore also be attributable to the setting it was embedded in. The recorded MW was also characterized by higher meta-awareness, which for its generally beneficial effects on MW likely contributed in facilitating the present combination of predominantly positive but

spontaneous generations. Additionally, while overall outcomes for AEs absent of and constituted by MW were indifferent, their intercorrelations differed vastly, suggesting that MW does shape the ways of AE.

Aesthetic experience, mind-wandering and the default-mode network

The general question remains how exactly MW relates to AEs. To make an account for this, the functioning of the default-mode network (DMN) will be drawn upon. The DMN is large-scale brain network primarily stretching across the medial prefrontal and retrosplenial cortex, the parietal lobe, the hippocampus and the nucleus accumbens. It is mostly known for its heightened baseline activity during passive states such as wakeful rest, reflecting the brain's intrinsic neural processing. Its discovery lays in a series of PET-studies conducted in the 1990's, which first showed these structures to quite synchronically decrease their activation with increasingly attention demanding cognitive tasks (Raichle et al., 2001). Generally speaking, the DMN's function can be summarized as being responsible for generating and upholding an egocentric perspective on the world, modelling the world with the self as its reference point, while its functional connectivity with other networks is responsible for an allocentric modelling of the world (Raichle, 2019).



Note. Figure adopted by Proulx et al., 2016, Spatial reference frames for cognition

To summarize, the DMN becomes increasingly suppressed during externally directed focussed attention and tasks that pull out of introspection. AEs are such tasks, strongly focussed on and fascinated with the object of their attention. Their common loosing of self, temporal- and environmental awareness speaks for the adaptation of an allocentric model of the world, and suppression of the DMN accompanies e.g. religious experiences (Walter & König, 2022) and the experience of awe (Van elk et al., 2019). On the other hand, DMN activity is unconstrained and high during task-disengaged states of introspection, such as MW (Zhou & Lei, 2018). AEs in their extreme and total absorption therefore likely reflect an allocentric pole, while MW when fully stimulus-independent is an example of the other side, the egocentric pole. The present finding for MW inside AEs to be of moderate perceptual decoupling, contents still relating to the broader experience at hand, and absorption to be lessened but overall, still high, likely means that these episodes of MW reflected brief pulls towards the egocentric direction on a spectrum of cognitive framing poles.

Implications

The implications of the present study are mainly theoretical. It showed that MW extensively constituted AEs, despite generally high absorption levels and happening in the sensory world, countering the phenomenon as constant in its captivation and external direction. It also replicated findings which go against MW as insulated from the environment, with its themes relating to those of the AE. Both these phenomena are therefore likely better modelled more expansively. Some aspects of the presently sampled MW seem to have been dependent on its context, which could be further assessed using SARTs, which likely mimic the attentional setting of AE. As a more extended implication, adopting an allocentric-egocentric cognitive spectrum as a framework likely holds great potential for further understanding and mapping the relation between AEs and MW.

Strengths and limitations

The present study had various strengths and limitations. A great conceptual strength was that AEs were generally reported as being high in absorption, which for its use to summarize the defining characteristics of AE, indicates conceptual validity. The emotional aspects of participants' AEs were also conceptualized using appraisal-theory and the measure used to assess emotions was theoretically built on it. The predominant adaption of Likert items allowed constructs to be measured dimensionally, which was in resonance with theorizing as heterogeneous component-streams. Yet, mean responses to these Likert items were often centred, which could speak for a central tendency bias throughout their repeated application. By being a diary study, or otherwise an ecological momentary assessment, real-time data collection was enabled, high in ecological validity and rich in detail. On the other hand, participants often made entries shortly after another, allowed to reflect upon more distant AEs, which might have conditioned those entries. The sample poses both a limitation and strength. While participation was open, it ended up drawing mainly on students recruited by SONA, making it essentially a convenience sample, rather homogenous in age group and other characteristics. The applied analysis also did not account for the nesting of data, which was supported by rather low intraclass correlations for entries within participants, but still poses a considerable statistical limitation. Type 1 error rates were therefore likely increased to an extent. Yet, its great sample size might have also countered these statistical limitations, drawing on over 200 entries made on AEs.

Conclusion

Despite being phenomena of deep engagement with the outer world, AEs have been reported to be extensively constituted by brief periods of MW. These wandering minds displayed a distinct profile, mostly spontaneously generated, focussed on the present, positive

in valence and associated with higher meta-awareness, which is likely attributable to the setting they arose in. MW was also described as not fully disconnected from the environment, but as featuring a degree of relation to the broader experience it was generated in. These findings therefore challenge traditional notions of both phenomena, where AE mean constant captivation by the external object, and MW means complete stimulus-independence.

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Appendix

Table 2

Instruments used in the D.E.A.R. Study

Inventory/Scale	Source	Purpose	Items/Method	Used in
Recalled aesthetic experiences – abridged version (RAE)	Buzzo & Sayim (2023)	Assessing specific characteristics over time, such as intensity, time perception, duration and trigger of the experience.	8 items: 2 Likert items (anchored individually but ranging from low to high), 4 multiple-choice items, 3 items allowing open answers	Diary entries
Perceived Stress Scale (PSS-10)	Lee (2012)	Measuring self-perceived stress levels of the last month	Likert scale (anchored at 1 = never, 5 = very often)	Pre and Post
Pick-a-mood	Desmet et al. (2016)	Assessing state mood	8 facial expressions represent distinct moods, one neutral option	Diary entries
Vienna Art and Interest Knowledge	Specker et al. (2020); Specker et al. (2023)	Assessing participants' art knowledge and interest	Scale Interest: 7 Likert items (anchored at 1 = not at all, 7 =	Pre

			very much), 4 Likert items (descripted across levels); Scale Knowledge: 6 multiple-choice items	
Self-reflection and Insight Scale (SRIS-12)	Silvia (2022)	Capturing engagement tendencies in self-reflection, need for self-reflection and internal state awareness	Shortened version, Likert scale (anchored at 1 = strongly disagree, 7 = strongly agree)	Pre
BSM	Nummenma et al. (2014)	Capturing areas of perceived bodily activation and deactivation	Pointing out on a body map where activity was felt intensified or diminished	Diary entries
The Geneva Wheel of Emotion 2.0 (GEW 2.0)	Scherer, K. R. (2005)	Assessing emotions constituting the experience	Placement of up to two emotion indictor points inside the wheel	Diary entries
Flow Short Scale	Laakasuo et al. (2022)	Assessing flow levels of the experience by subscales capturing absorption and fluency levels	Likert scale (anchored at 1 = strongly disagree, 7 = strongly agree)	Diary entries

Questionnaire for Mind-Wandering	Composed of 3 items adopted from Taruffi (2021), 4 items from Deil et al. (2022), 1 item from the Mind-Wandering Inventory (MWI) (Gonçalves et al., 2020)	Capturing MW occurrence and assessing its components	1 multiple-choice item; 6 Likert items (anchored individually but ranging from low to high); 2 multiple-choice items	Diary entries
The Plymouth Sensory Imagery Questionnaire (Psi-Q)	Andrade et al. (2013)	Assessing participants' mental imagery ability across 7 sensory modalities and one global score (e.g. visual, sound, smell, taste, touch, bodily sensation, feeling)	35 items with 5 items making one of 7 subscales. Response ranging from (0) "No image at all" to "Perfectly clear and as lively as seeing it for real" (10)	Post

Table 3

Questionnaire composed to measure mind-wandering

Item	Question/Description	Format	Source

Valence	"Was the content of your thoughts/images negative, neutral, or positive?"	Likert item with end points 1 (negative) and 7 (positive)	Taruffi (2021)
Meta-awareness	"How aware where you of where your attention was focused?"	Likert item with end points 1 (completely unaware) and 7 (completely aware)	Taruffi (2021)
Intentionality	"Considering how your mind-wandering came about, please select one of the following options."	3-set multiple choice item with options: 'I allowed my thoughts to wander on purpose', 'I found my thoughts wandering spontaneously' or 'I don't know'.	Taruffi (2021)
Frequency	"How regularly did mind-wandering occur to you during the aesthetic experience?"	Likert item with end points 1 (once) and 7 (all the time)	Deil et al. (2022)
Duration	"How long did the episodes of mind-wandering generally last?"	Likert item with end points 1 (seconds) and 7 (several minutes)	Deil et al. (2022)

Content-proximity	"How related to the aesthetic experience were your mind wandering thoughts?"	Likert item with end points 1 (not related at all) and 7 (entirely related)	Deil et al. (2022)
Temporality	"Please indicate the temporal direction of your mind-wandering."	3-set multiple choice item with options: 'My mind wandering was future-related', 'My mind wandering was past-related', or 'My mind wandering was present-related'.	Deil et al. (2022)
Perceptual decoupling	"To what degree did your mind disconnect from what surrounded you during the mind-wandering?"	Likert item with end points 1 (slightly disconnected) and 7 (fully disconnected)	MWI

Table 5

Differential time perception

Valid N = 228	Frequency	Percentage (%)
No	80	35.4
Yes	27	11.9
Yes, I lost track of time	43	19.0
Yes, time passed faster	36	15.9
Yes, time passed slower	40	17.7

Note: Question: "Did you experience time differently during the experience?".

Table 6

Frequency counts for intensity constancy or alternation

Valid N = 218	Frequency	Percent (%)
Yes	127	56.2
No	10	4.4
No, it was more intense at the beginning	49	21.7
No, it was more intense at the end	20	8.8
No, it was more intense in the middle	12	5.3

Note: Question: “Did intensity remain constant throughout the experience?”

Table 8

T-tests comparing means for AEs with and without changes in intensity

Variable	Type of t-test	Leven's test F	Leven's test p	t statistic	df	Two-sided significance	Mean difference	Std. Error difference
Appreciation	Equal variances assumed	3.24	.073	0.231	213	.818	.04	.17
	Equal variances not assumed							
Meaning	Equal variances assumed	0.03	.86	-0.36	216	.72	-.072	.201
	Equal variances not assumed							
Intensity	Equal variances assumed	1.62	.21	0.33	216	.74	.07	.202
	Equal variances not assumed							
Duration	Equal variances assumed	0.245	.621	-0.33	213	.74	-4.15	12.46
	Equal variances not assumed							

Emotional valence	Equal variances assumed	<.001	.934	0.14	208	.89	0.007	0.05
	Equal variances not assumed							
Emotional intensity	Equal variances assumed	0.10	.75	-0.06	208	.529	-0.01	0.002
	Equal variances not assumed							
Emotional arousal	Equal variances assumed	<.001	.93	0.139	208	.622	-0.003	0.05
	Equal variances not assumed							
Fluency	Equal variances assumed	0.328	.57	1.14	216	.255	0.81	0.71
	Equal variances not assumed							
Absorption	Equal variances assumed	.079	.73	0.231	216	.524	0.34	0.53
	Equal variances not assumed							

MW frequency	Equal variances assumed	5.68	.019	1.27	81	.205	0.45	0.35
	Equal variances not assumed							
MW duration	Equal variances assumed	7.92	.006*					
	Equal variances not assumed			2.40	82	.019	0.72	0.30
MW valence	Equal variances assumed	1.94	.167	-0.42	81	.678	-0.13	0.31
	Equal variances not assumed							
MW MA	Equal variances assumed	0.28	.597	0.81	81	.419	0.26	0.32
	Equal variances not assumed							
MW duration	Equal variances assumed	7.92	.006*					
	Equal variances not assumed			2.40	81	.019*	0.72	0.30

MW content proximity	Equal variances assumed	2.83	.096	1.35	81	.18	0.48	0.36
	Equal variances not assumed							

Note. df = Degrees of freedom. $^{*}p < .05$. $^{**}p < .01$

Table 9

T-tests comparing means for AEs with and without alternated time perception

Variable	Type of t-test	Leven's test F	Leven's test p	t statistic	df	Two-sided significance	Mean difference	Std. Error difference
Appreciation	Equal variances assumed	8.42	.004*					
	Equal variances not assumed			4.16	119	<.001**	0.77	0.19
Meaning	Equal variances assumed	3.30	.083	4.56	224	<.001**	0.88	0.19
	Equal variances not assumed							
Intensity	Equal variances assumed	0.98	.322	4.56	224	<.001**	0.89	.20

	Equal variances not assumed							
Duration	Equal variances assumed	12.2	<.001*					
	Equal variances not assumed			3.622	207	<.001**	40.76	11.25
Emotional valence	Equal variances assumed	0.45	.503	1.25	216	.212	0.06	0.05
	Equal variances not assumed							
Emotional intensity	Equal variances assumed	2.53	.12	2.24	216	0.013*	.026	0.05
	Equal variances not assumed							
Emotional arousal	Equal variances assumed	0.08	.778	0.20	216	.84	0.01	0.06
	Equal variances not assumed							
Fluency	Equal variances assumed	0.72	.397	3.48	224	<.001**	2.46	0.705

	Equal variances not assumed							
Absorption	Equal variances assumed	0.023	.88	3.35	224	<.001**	1.79	0.53
	Equal variances not assumed							
MW frequency	Equal variances assumed	1.03	.313	0.44	86	.66	0.17	0.39
	Equal variances not assumed							
MW duration	Equal variances assumed	0.007	.934	.353	86	.725	0.13	0.36
	Equal variances not assumed							
MW valence	Equal variances assumed	0.238	.627	-.012	86	.991	-.004	0.328
	Equal variances not assumed							
MW MA	Equal variances assumed	0.01	0.92	.501	86	.617	0.17	0.34

	Equal variances not assumed							
MW duration	Equal variances assumed	0.007	.93	.353	86	.725	0.13	0.36
	Equal variances not assumed							
MW content proximity	Equal variances assumed	1.84	0.18	-.622	86	.536	-0.236	0.38
	Equal variances not assumed							

Note. df = Degrees of freedom. $^{*}p < .05$. $^{**}p < .05$.

Table 14

T-tests comparing AEs absent of MW with AEs constituted by MW

Variable	Type of t-test	Leven's test F	Leven's test p	t statistic	df	Two-sided significance	Mean difference	Std. Error difference
Appreciation	Equal variances assumed	2.51	.114	1.43	220	.153	0.25	0.17
	Equal variances not assumed							

Meaning	Equal variances assumed	0.19	.664	-0.19	224	0.844	.0,04	0.19
	Equal variances not assumed							
Intensity	Equal variances assumed	2.73	.10	0.79	224	.433	0.16	0.20
	Equal variances not assumed							
Duration	Equal variances assumed	2.23	.137	-0.89	221	.387	-10.79	12.43
	Equal variances not assumed							
Emotional valence	Equal variances assumed	0.27	.60	-0.54	216	.666	-0.2	.04
	Equal variances not assumed							
Emotional intensity	Equal variances assumed	2.29	.131	-0.18	216	.853	<.001	0.02
	Equal variances not assumed							

Emotional arousal	Equal variances assumed	0.10	.75	-1.14	216	.157	-.08	0.06
	Equal variances not assumed							
Fluency	Equal variances assumed	0.17	.664	-0.43	216	.106	1.44	0.76
	Equal variances not assumed							
Absorption	Equal variances assumed	0.74	.391	-3.918	224	<.001**	-2.02	0.52
	Equal variances not assumed							

Note. df = Degrees of freedom. $^{*}p < .05$. $^{**}p < .01$