The Dynamics of Self-Evaluation

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Abstract

The process of self-evaluation is one that individuals engage in daily, often multiple times per day. Prior research has found that a dynamics systems approach to studying self-evaluation can lend particular insights into how psychological constructs such as self-esteem develop (Vallacher, Nowak, Froelich, & Rockloff, 2002). This research focuses on examining time series data on self- and other-evaluation using a fractal analysis, comparing the evaluations of the self versus the other, as well as investigating relationships between measured psychological constructs relating to the self. This was done in an effort to gain insight into the underlying factors behind patterns of evaluation. The results revealed relationships between self-evaluation dynamics and self-esteem, self-concept clarity, stability of self, childhood trauma, narcissism, and self-consciousness. Other-evaluation was found to be similar to self-evaluation when comparing variability and dynamism, and dissimilar when comparing the affective tone of judgements. Finally, self-evaluation was found to be scale-free when a spectral analysis was used to look at the evaluation trajectory variables.

Acknowledgements

I would like to thank my supervisors Dr. Georg Northoff and Dr. Mark MacLeod for their continuous support throughout this process. Their compassion and understanding through the difficult events of 2020 have been crucial to the completion of this thesis.

A special thank you goes to Dr. Annemarie Wolff, even though she was not a formal supervisor, she was always available for consultation and she did a great deal to aid experimental procedure.

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The Dynamics of Self-Evaluation

Selfhood is a complex human phenomenon which can, according to Gallagher and Zahavi (2012) be disassembled into two substrates. The first form, the minimal self, is the aspect of selfhood which is integral to the sense of "mineness" intrinsic to phenomenological consciousness (Gallagher & Zahavi, 2012). The second form, the narrative self, can be conceived of as the aspect of selfhood which generates an individual identity (Gallagher 2000). Together, the two forms of the self are layered on top of each other to create a multi-laminar self which guides the individual through life via integration of the "now" with the overall perception of who they are. For the purposes of this paper, it can be assumed that I am referring to the narrative self whenever I reference the notion of the "self". The self therefore represents the subjectivities and nuances of an individual being from the first-person perspective. Whether it is how one looks or how one acts, the self is uniquely expressed in the mind's eye, making it inaccessible to the outside world, arguably the biggest challenge faced by mental health professionals when trying to deal with pathologies of the psyche. Though there are many researchers that debate the definition of the self and its origins, there has been increasing interest in the mechanics of the self. In this paper I will be examining time series data on narrative evaluation using various analyses to examine the dynamics of self-referential cognition. I will also be investigating relationships between measured psychological constructs relating to the self to gain insight into the underlying factors behind patterns of narrative evaluation. Analysed contiguously, these two principal aims should lend insight to the "how" and "why" of the dynamics of self-evaluation, respectively.

Self-Structure

The basic functions of the narrative self, such as regulating action, seem to hinge on *elements* of self-understanding (Vallacher, Nowak, Froelich, & Rockloff, 2002). In a given context an individual chooses the actions that make the most sense to who they are, what ambitions they might have etc. Elements in this case loosely represent values extracted from memories of success, failure, and social interactions, as well as goals and aspirations. They play a crucial role in shaping how people think of themselves, how they lead their lives, and are often cited as reasons for their behaviour. To gain insight into oneself, self-evaluation, otherwise described as a session of self-referential cognition, must be employed. When performing a self-evaluation, an individual may consider themselves in many different aspects to gain a better understanding of who they are and how they are perceived by others, and their subsequent trajectory through life is based on a foundation made up of these unique elements. Despite the multitude of things that could be classified as an element, there is a common currency when it comes how people evaluate themselves. For example, the self-perceived element of "shyness" may take on a positive valence in the context of other qualities which collectively curate the image of someone who is introverted or reserved. Additionally, people tend to see disparity between their own reality and these cognitive elements as something negative, which, if not ameliorated, can cause an individual to perceive themselves undesirably. For example, drinking and driving is a social more, and an individual who engages in it repeatedly will most likely feel some level of guilt or lowered sense of self-worth upon reflection.

Self-evaluation is therefore a valuable enterprise for the human mind and is a system that plays a prominent role in an individual's quality of life. It is exactly these aforementioned cognitive elements which form a putative "platform" upon which the individual may perform

self-evaluation. The platform is ever-shifting –able to accommodate new information into its structure, dictating the flow of self-relevant cognitions at any given moment. Vallacher, Nowak, Froelich, and Rockloff (2002) define this platform as a *self-structure*, a complex and self-organizing system that affects global properties like self-esteem and self-certainty. Global properties are ones that require consideration of the whole object (or in this case, person) rather than local phenomenology.

Emerging Coherence and Stability of Self-Structure

The model of self-structure (Vallacher, Nowak, Froelich, & Rockloff, 2002) is meant to elucidate the causal chain of events which determine how positively and clearly an individual perceives themselves to be over time (Sharp-Davidson, 2015). In this section I will discuss how the self-structure organizes itself. As discussed earlier, each element in the self-structure represents a trait, taking on a valence. Elements range from positive to negative valence, indicating whether an individual feels they exemplify a given trait or not. For example, should a person be a professional athlete, they probably have a firm understanding that they are more athletic than the average person, so their "athletic" element would take on a positive valence. Elements also vary in stability, with traits that are well-reinforced taking on a greater stability than those that are not.

The most stable element in a group of related elements is termed an *attractor state*, named for its tendency to be a frequent point of reference for the individual. An attractor state can be likened to a ball in the bottom of a bowl, a fixed and stable point in a dynamic system (Miller, 2016). A strong attractor is resistant to varied feedback due to a vast database of memories that reinforce its valence as either negative or positive. Because the self-structure tends to differentiate elements into evaluatively relevant clusters, there is likely to be more than one

attractor state. It is theorized that while performing a self-evaluation, an individual may initially query some part of themself, but their thought process will likely move through to the more stable elements in their self-structure (Vallacher et al., 2000), just as the ball rolling in the bowl will eventually come to a stop at the deepest point. In an individual with a *coherent* self-structure, the self-structure is organized in a way in which there are clusters of negative- and positive-valenced elements that form concentric grouping around the attractor state(s). However, in a region of the self-structure with low evaluative coherence (weak attractor state), the self-evaluation is characterized by inconsistent and often contrasting beliefs. Figure 1 shows the putative model of the self-structure (Vallacher, Nowak, Forelich, & Rockloff, 2002). The coherency and stability of the self-structure is largely established by how well a person knows themself, and how stable this knowledge is over time. In light of this, people who have a lower self-concept clarity and a lower self-concept stability are more susceptible to self-structure reorganization based on varied outsider feedback. With this in mind, the coherence of a self-structure dictates the dynamics of self-evaluation in a way wherein highly coherent organization results in less variability of self-related cognitions.

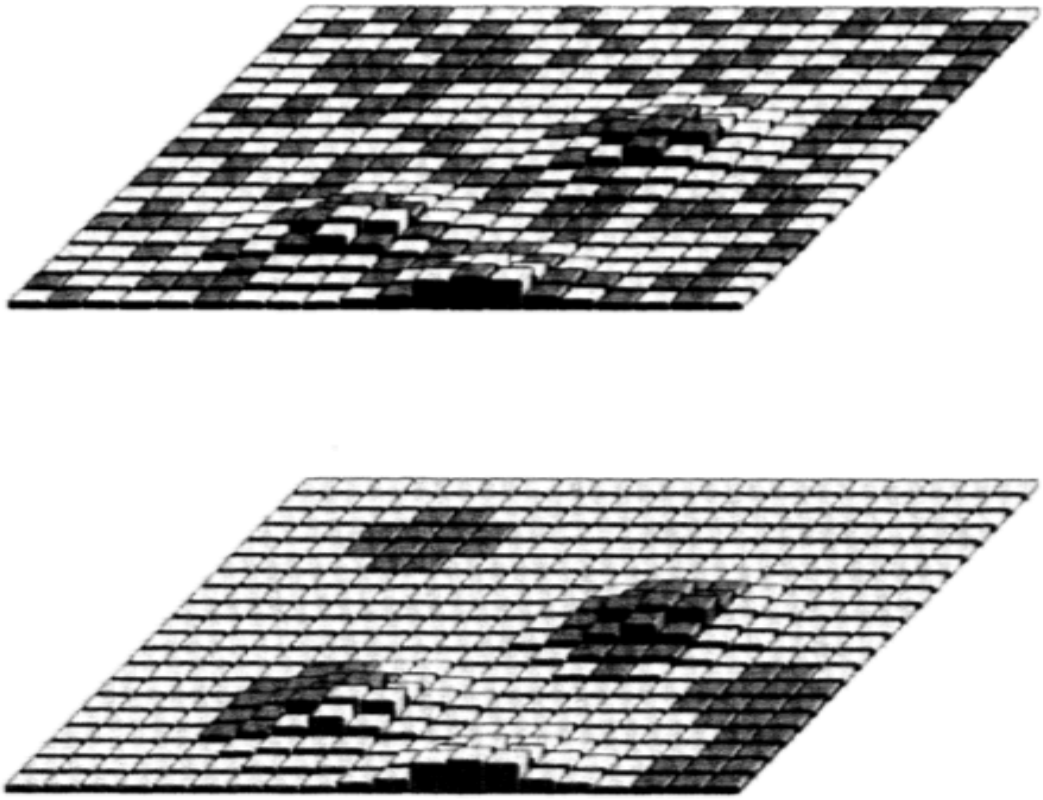
In the study by Vallacher, Nowak, Froelich, and Rockloff, (2002) their experiments validated this model of the dynamics of self-evaluation. They found that the self-esteem, or global positivity in the self-structure, dictated the self-evaluation in that higher levels of self-esteem promoted more positive self-relevant thoughts and vice versa for low levels of self-esteem. Certainty and stability in the self-structure was manifested in the dynamic properties of the self-evaluation wherein lower certainty and stability was associated with a rapid and varied stream of self-referential cognition over time. Among all participants, the researchers found that the evaluative tone seemed to grow more stable towards the end of the evaluation, which is

posited to represent the stream of thoughts converging on a state of maximal coherence, irrespective of whether the participant had a higher or lower self-esteem. Even when priming effects (being asked to recount a negative or a positive story about oneself) were introduced, they wore off by the end of the evaluation. The implication for these results is that when evaluatively inconsistent information is integrated into a region with high coherence, it is likely that it will be discounted due to the collective influence of the surrounding elements. If a person has a generally negative view of themselves, positive feedback will have little to no effect on improving that perception as the interacting influences amongst elements in the negative feedback loop work to reinforce one another.

To test the coherence and stability of the self-structure amongst our own participants, we administered several questionnaires. The Rosenberg Self Esteem Scale (Rosenberg, 1965) was first used to measure how positively participants perceive themselves (see Appendix A). We also administered Beck's Depression Inventory (BDI) (see Appendix B) (Steer, Beck, & Garrison, 1986) and the Childhood Trauma Questionnaire (CTQ) (see Appendix C) (Bernstein, Fink, Handelsman, & Foote, 1994) to screen for symptoms of major depressive disorder (MDD), as childhood trauma has been an observed risk factor for psychiatric illness (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008). It has long been purported that self-esteem and quality of life are heavily intertwined and that MDD reduces individual sense of self-worth (Nnadozie, 2017). The Pathological Narcissism Inventory (PNI) (see Appendix D) was used to screen for narcissistic traits Pincus, 2013). Since the present study aims to examine the dynamics of self-evaluation in healthy participants, any individual scoring high on the above questionnaires was excluded from the analyses (none were excluded). To test self-concept clarity, we administered the Self-Concept Clarity Scale (SCC) (see Appendix E) (Campbell et al., 1996) and Rosenberg's

Figure 1

Model of Self-Structure Organization



Note. Visualization of an incoherent (top image) and a coherent (bottom image) self-structure. Dark grey squares represent negative-valence elements and light grey squares represent positive-valence elements. Height of squares represents stability of the elements. Figure reprinted from Vallacher, R. R., Nowak, A., Froehlich, M., & Rockloff, M. (2002).

(1965) four-point Self-Esteem Instability Scale (SEIS) (see Appendix F), which both relate to how stable and coherent the elements in the self-structure are. Self-consciousness is another construct which was included as a measured variable via the use of the Self-Consciousness Scale (SCS) (see Appendix G) developed by Fenigstein, Shceier and Buss (1975), as self-consciousness and self-esteem are closely related (Cheek & Melchior, 1990). These scales were later analyzed using a principle component analysis.

Overview of Research Strategy

Due to the hypothesized link between the structure and dynamics of self-evaluation (Vallacher et al., 2002), our experimental paradigm required sampling with a high degree of temporal resolution (200 Hz). We adapted our methods from Vallacher et al. (2002) who used the mouse paradigm previously used in research about the dynamics of social judgement. The participants were asked to describe themselves into a microphone as fully and as honestly as they could. The participants then used a mouse cursor to rate statements in their recorded personal narrative by moving it closer or farther away from a target at the centre of the computer screen. By tracking the cursor position frame-by-frame we collected data on cursor position which was divided into independent variables cursor *position*, *distance* from centre and *velocity* which charted a trajectory for the participants' sentiments towards their stream of consciousness narratives. Position and velocity were used to assess the stability and coherence of the participants' self-structures by tracking how much and how rapidly the cursor was moved. According to the hypothesis about the tendency for thought to move towards an attractor state, the rate of change in position (velocity) as well as the frequency of change in position of the cursor should decrease towards the end of the evaluation task, and should have less variability overall for participants with a higher self-structure coherence and stability. Distance from the

centre was used as a measure of overall positivity/negativity. If previous hypotheses are correct, then individuals scoring higher on the self-esteem scale should have a lower overall distance from the centre. All individuals should also hypothetically see less variability in distance from the target towards the end of the evaluation task, as in the original experiment.

Otherness

Despite the fact that the self can only be fully accessed by the person who ascribes it to themself, it is the presence of other people that can activate self-relevant thought at any moment (Vallacher, Nowak, Froehlich, & Rockloff, 2002). Jung (1988) wrote that the self "plants us in otherness" which is to say that in order to individuate one must (seemingly paradoxically) exist amongst other people. Along a similar vein Charles Horton Cooley (1983) wrote "each to each a looking glass, reflects the other that doth pass," in reference to his theory of the Looking-glass self. Cooley's work highlighted the way in which an individual's sense of self is derived from perceptions of others, their overt or covert social judgements acting as a mirror of sorts. Seeing as the perceptions of others seem to have a large effect on self-value (as hypothesized by both Jung and Cooley) the current study expanded the original experimental paradigm (Vallacher, Nowak, Froehlich, & Rockloff, 2002) to include otherness within the realm of selfhood.

We ran a very similar task as described in the overview section on the same participants to explore whether the dynamics of social judgement function similarly when applied to the self compared to the other. Participants used the mouse cursor to rate the statements in a pre-recorded personal narrative and this data was compared to the mouse cursor movements in the self condition. In order to eliminate between subjects differences, each participant partook in this condition.

Scale Free Properties of the Brain and the Self

Thus far I have discussed the self from a psychological and cognitive perspective. In this section I will discuss the dynamics of cortical brain activity and how they are similar to the theorized dynamics of the self. The human brain is organized into local nuclei which form a large-scale interconnected network. This complex system is able to continuously reorganize and synchronise with disparate biological structures on an extremely fine-grained temporal scale, much like our model of the self. Though our body and environment are in a constant state of change, the temporal continuity of the self allows it to endure and remain largely stable over time. The self has the task of integrating fleeting external stimuli and psychological processes with a much longer timescale, thus operating unbound by just one timescale. Because of this, the self can be described as "scale-free." Scale-freeness is a concept used to describe a network in which its elements are independent of its size, meaning that when the network grows or changes, the underlying structure remains the same (Kolvoort, Wainio-Theberge, Wolff, & Northoff, 2020). For this reason, a spectral analysis was used to later analyse the data.

Electroencephalography (EEG) is a technique used in neuroimaging that provides real-time information on the change in electrical potential across the scalp (and hence the activity of the neurons underneath). The brain's spontaneous activity is expressed in oscillatory patterns. These patterns are defined by stages of varying frequencies, from ultrafast (40-180 Hz) to infraslow ones (0.01-0.1 Hz). Power (the amount of activity at a given frequency band) has an inverse relationship with frequency wherein high power is observed at lower frequencies and vice versa. This pattern follows a power law distribution wherein power is proportional to the inverse of the frequency raised to the power (expressed as a formula below) which can also be described as scale-free (Kolvoort, Wainio-Theberge, Wolff, & Northoff, 2020).

$$P \propto 1/f^{\beta}$$

The invariance observed in statistical properties of biological signals in the brain denotes the constancy of the relationship between frequency and power irrespective of the magnitude of the timescale, suggesting continuity much like it did when applied to the self. Because of this parallel, A significant portion of the current experimental paradigm was performed under EEG. For the purposes of this honours thesis, this topic will not be explored in-depth. However, it is important to lay the foundation for comparison between the dynamics of the brain and the self.

Methods

The purpose of the experiment was to gather behavioural and neurological data about the nature of individuals' self-evaluative thought patterns. Questionnaires were administered to aid in making conclusions about differences between participants. The methods of this study are partially based on those used by Vallacher, Nowwak, and Rockloff (2002).

Participants

Ten healthy female and sixteen male participants (n = 26) between the ages of 19 and 71 (M = 30.6, SD = 14.2) were recruited by word of mouth. Participants were compensated $60 CAD in cash after completing the experiment.

Materials

A personal laptop was used to record the personal narratives. A set of headphones was used by the participant to listen to the narratives. A computer mouse and monitor were used for the evaluation procedure.

EEG activity was recorded using a 64-channel actiCAP (Brain Products GmbH, Germany) with electrodes at Fp1, Fp2, AF7, AF3, AF4, AF8, F7, F5, F3, F1, Fz, F2, F4, F6, F8, FT9, FT7, FC5, FC3, FC4, FC6, FT8, FT10, T7, C5, C3, C1, Cz, C2, C4, C6, T8, TP9, TP7, CP5, CP3, CP1, CPz, CP2, CP4, CP6, TP8, TP10, P7, P5, P3, P1, Pz, P2, P4, P6, P8, PO9, PO7, PO3, POz, PO4, PO8, PO10, O1, Oz, and O2, reference electrode at FCz and ground electrode at AFz (see Appendix H) according to the extended International 10–20 Systems. The impedance of all channels was measured at less than 5 kΩ before recording was initiated and remained below this level for the duration of the recording. The signal was amplified (actiCHamp) and the

unfiltered data was recorded at a sampling frequency of 1000 Hz using the EEG BrainVision Recorder (Brain Products GmbH, Germany).

Procedure

The experimental procedure can be broken down into four stages. In the first stage participants filled out the informed-consent form (see Appendix I) while the EEG cap was being assembled based on head measurements which were provided by the participants prior to their arrival at the lab. Afterwards, participants were instructed to record an eight-minute personal narrative on the laptop of one of the researchers, using a free online recording application (123apps, 2012). Participants were told to describe themselves in terms of traits, accomplishments, and goals but were told to leave out their name for the sake of anonymity.

In the second stage, the participants' self-narrative recordings were transferred to the lab computer and set up for the third stage of the experiment. BIP2AUX (bipolar-to-auxiliary adapter) electrodes measuring heart rate, eye blinks, and saccades as well as grounding electrodes were taped to the participant's face and body. Each participant was then seated in a chair in front of the lab computer thirty cm away from the monitor at eye level. The researchers fitted the EEG cap with sixty-four electrodes onto the participants heads, making sure that participants' hair and scalp had been freshly washed and dried. Once the cap was secured and conductive gel had been inserted between the electrodes and the scalp, all lights and electronics were turned off.

In the third stage, the participants sat straight and motionless with their feet planted on the ground and their eyes open and fixated on a target displayed on the computer monitor. Their brain activity was measured for eight minutes in order to gather resting state data (baseline) via the EEG electrodes. The participants then completed three more tasks in front of the computer

with the EEG cap on, in a randomized order. All tasks were eight minutes in length and performed in silent and dark conditions. Participants were encouraged to take breaks in between tasks to relax and reposition.

In two of the subsequent tasks, the participants were instructed to put on headphones and listen to an audio recording. These two tasks were identical except that in one of the tasks the participants were evaluating their own personal narrative while in the other they were evaluating a stranger's personal narrative (same stranger narrative was used for all participants). As the recording was playing, participants evaluated the statements in real time by moving the mouse cursor in relation to a target displayed in the centre of the computer monitor. The closer the cursor is positioned to the target, the more positive the statement is, and the farther away, the more negative. Participant cursor trajectories were recorded using a script coded in python.

In the final task the participants were instructed to evaluate their spontaneous thought patterns in the same way as previously described. After this, the EEG cap was removed, and the participants were instructed to wash their hair before stage four.

The final portion of the experiment involved completing questionnaires relating to how the participant felt during the tasks, about their childhood, mental health, and sense of self, as well as a demographic information sheet (see Appendix J).

Data was analyzed using Matlab (MATLAB, 2010), IBM SPSS Statistics (IBM Corp, 2017) and Jamovi (The Jamovi project, 2020).

Results

Mean Differences in Trajectory Variables

An independent samples t-test was conducted to compare participant trajectories (velocity, position, and distance) in self and other conditions. The test showed that there were no significant differences between the velocity variable in the self (M = 0.190, SD = 0.279) versus the other condition (M = 0.191, SD = 0.417); $t(51)$ = -.006, p = .996. This indicated that participant cursor movement speed did not vary depending on whether they were evaluating their own or an other's narrative. There was no significant difference observed for the position variable in the self (M = 928.553, SD = 270.806) versus the other condition (M = 960.588, SD = 196.559); $t(51)$ = -.491, p = .625 suggesting that narrative ownership also did not affect the changes in cursor position. There was a significant difference $t(51) = 2.019$, $p < 0.05$ observed in the distance variable in the self (M = 289.417, SD = 270.806) versus the other condition (M = 209.404, SD = 196.559) suggesting that overall ratings of positivity versus negativity differed based on narrative ownership (figure 2). However, the effect size was moderately small (d = 0.34). See Table 1 for a complete list of all means and standard deviations.

Analysis Split by Time Period

A one-way ANOVA was used to test whether mean scores on trajectory variables were significantly different between time periods. The data was split into three time periods. There were no significant differences found in the distance variable ($F(158) = .047$, p = .954), position variable ($F(158) = .001$, p = .999), nor Velocity variable ($F(158) = .680$, p = .508), not supporting the hypothesis that self-evaluation dynamics are affected by an attractor state.

Table 1

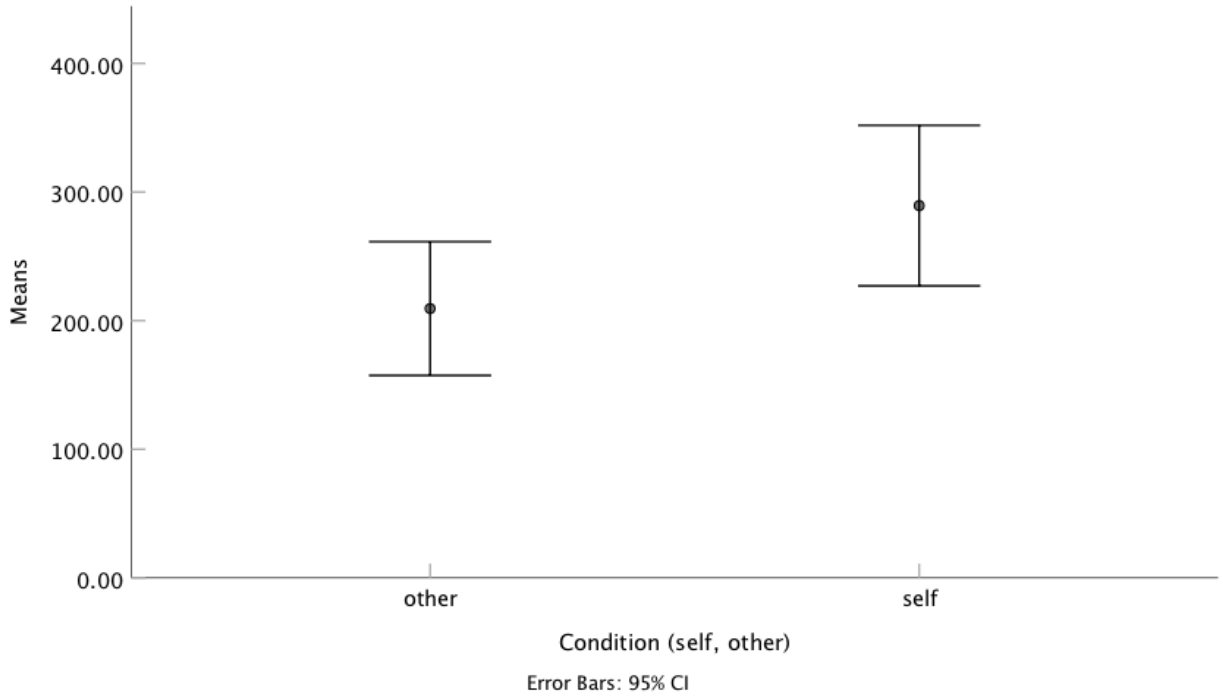
Means and Standard Deviations of Variables in the Self and Other Condition

		Descriptives		
Condition	Variables	*n*	*M*	*SD*
Self	Velocity	27	0.190	0.279
	Position	27	928.553	270.806
	Distance	27	289.417	157.680
Other	Velocity	26	0.191	0.417
	Position	26	960.588	196.559
	Distance	26	209.404	128.780
Total	Velocity	53	0.190	0.350
	Position	53	944.268	235.593
	Distance	53	250.165	148.444

Note. Missing data in the *other* condition.

Figure 2

Error Bar Chart Comparing Mean Distance in Both Conditions



Note. Significant difference observed between the other and self condition on the distance variable.

Correlations Between Trajectory Variables

A two-tailed bivariate correlation analysis was used to determine the existence of relationships between the variables, which showed no significance between velocity and distance $r(51) = -.120$, $p = .392$, nor velocity and position $r(51) = -.025$, $p = .860$, indicating that velocity was independent of both changes in cursor position and distance from the target (negative/positive sentiment). There was a significant but weak positive correlation between the distance and position variables $r(51) = 2.77$, $p < .05$, showing that as distance from the centre increased, so too did the amount of change in cursor position. This relationship is visualized on a scatterplot in figure 3.

Fractal Analyses on Trajectory Data

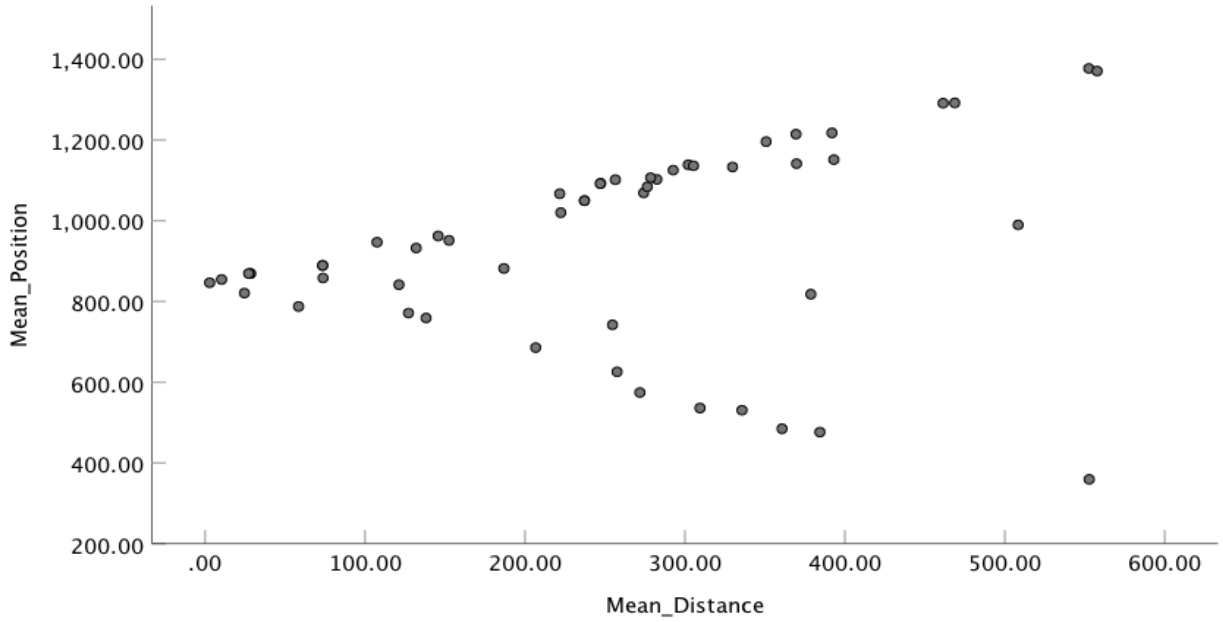
Fractal analyses, generally applied to data in biological or economic studies, are a novel way to measure behavioural data based on temporal patterns (Rutherford, Haskell, Glasbey, Jones, & Lawrence, 2003). A part of this experiment aimed to see if behavioural data (i.e., the mouse cursor trajectories collected during the narrative evaluations) would produce a scale free signal. We used a Power Spectral Density analysis to look at the signal of each variable in the self versus the other condition. As can be observed by the plots in Figure 4, the power of the signal was highest at lower frequencies, following a power law distribution in all three trajectory variables. This supports the hypothesis that behavioural data patterns relating to the self are in accordance with neuronal signals relating to the self.

Overview of Psychological Scale Data

To look at the distribution of scores for each psychological scale, the data was visualized using density plots (Figure 5). The average score for the Childhood Trauma Questionnaire was 42.5 ($SD = 18.5$) (Figure 5A) showing that most participants scored lower in childhood trauma.

Figure 3

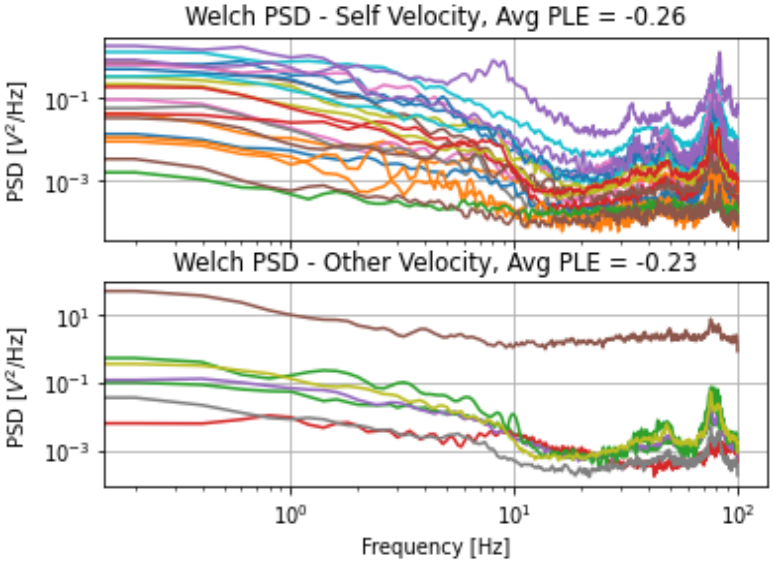
Correlation Between Mean Distance and Mean Position

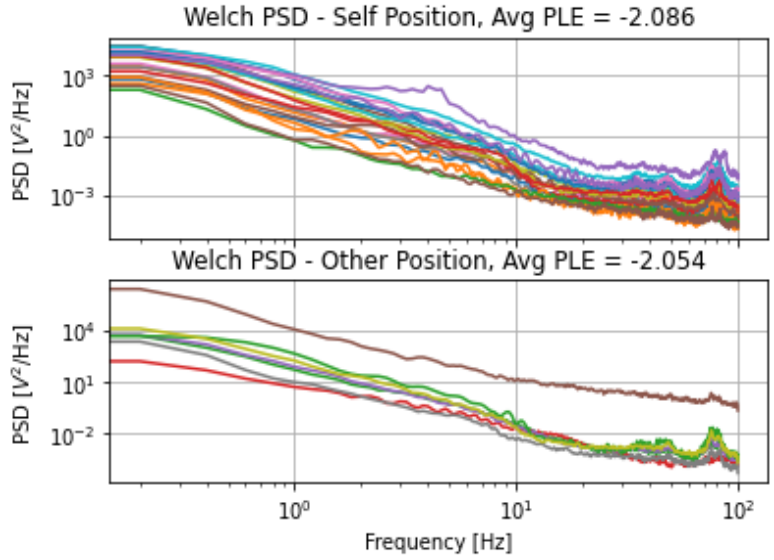


Note. Significance is at an alpha level of .05. Based on the distance, position changes accordingly.

Figure 4

Power Spectral Density Plots for Velocity, Distance, and Position in Both Conditions





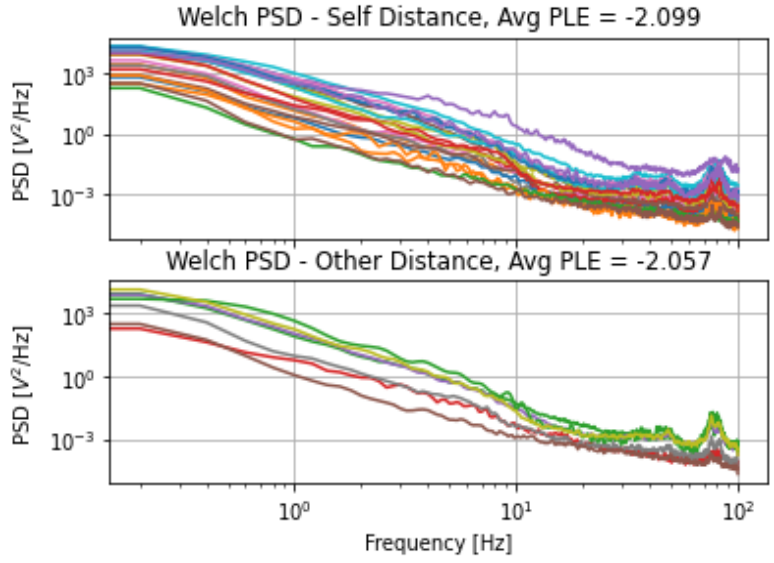
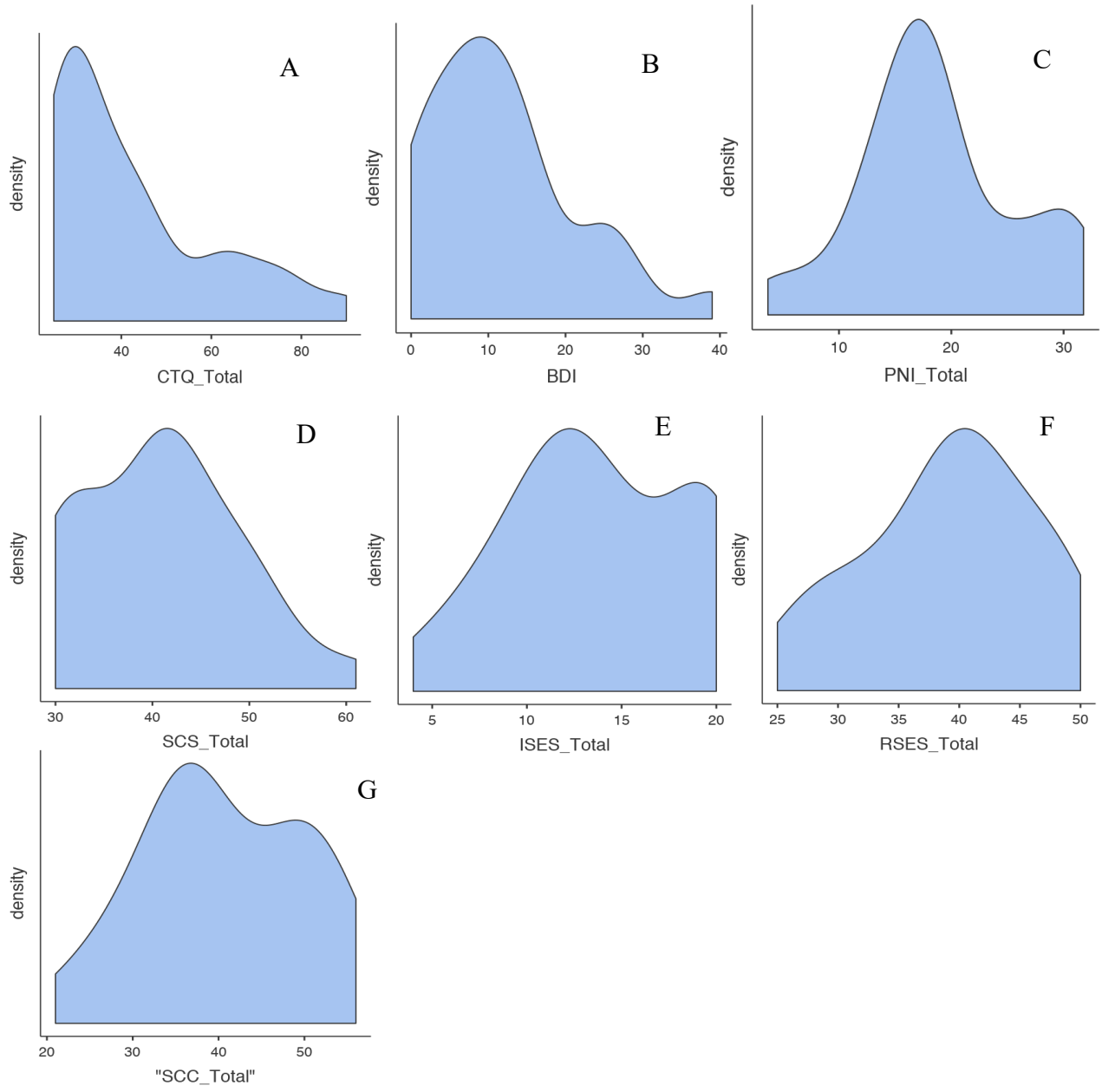


Figure 5

Density Plots Displaying the Distribution of Scores for Each Questionnaire



The average score for Beck's Depression Inventory was 11.8 (*SD* = 18.5), indicating that depression scores for this dataset were mostly grouped in the lower percentiles (Figure 5B). The average score for the Pathological Narcissism Scale was 18.7 (*SD* = 7.05), indicating that total narcissism scores were mostly grouped around the mean (Figure 5C). The average score on the Self-Consciousness Scale was 40.7 (*SD* = 9.53) indicating low to mid self-consciousness across participants (Figure 5D). The average score on the Instability of Self Scale was 13.8 (*SD* = 4.74) Indicating a (Figure 5E). The average score on the Self-esteem scale was 39.1 (*SD* = 6.99) indicating that self-esteem scores were mostly centred around the mean (Figure 5F). The average score on the Self-Concept Clarity Scale was 40.7 (*SD* = 9.53) which indicated that self-concept clarity scores ranged from mid to high (Figure 5G).

Principal Components Analysis

To find underlying constructs in the psychological data, a Principle Components Analysis (PCA) was used. Six principal components were extracted based on the Kaiser method (eigenvalue > 1). Varimax rotation was used to better differentiate the components. Table 2 shows the explained variance of rotated sums of squared loadings. Together the components accounted for 83.8% of the variance, with the first three explaining 56% (component 1 = 22.4%, component 2 = 19.2%, component 3 = 14.6%). The last three components only explained 27.6% of the data (component 4 = 10.95%, component 5 = 9.14%, component 6 = 7.5%) but were included in the analysis for a more dimensional understanding of correlations of responses.

To interpret each principal component, loadings of > .4 were persevered and the questionnaire variables with the highest loadings were used for naming. Component one, named Narcissistic Self showed high positive correlations for all items of the PNI. Subscales of the PNI

Table 2

Explained Variance in Six-Component PCA

	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
Component 1	5.15	22.391	22.391
Component 2	4.415	19.195	41.586
Component 3	3.367	14.639	56.225
Component 4	2.518	10.949	67.174
Component 5	2.102	9.141	76.315
Component 6	1.722	7.487	83.802

Note. Total column represents eigenvalues.

were taken from Pincus (2013) and included Entitlement Rage (ER), Grandiose Fantasy (GF), Devaluing (DEV), Hidden Self (HS), Self-Sacrificing Self-Enhancement (SSSE), Exploititiveness (EXP), and Contingent Self-Esteem (CSE). This principal component lends validity for the PNI as a measure of personality aspects of narcissism. The component loadings for each of these items are displayed in Table 3.

The second component was termed Trauma-Affected Self as it had high loadings for all items of the CTQ and the BDI which were negatively correlated with RSES. Subscales for the CTQ were taken from Bernstein, Fink, Handelsman, and Foote (1994) and included Physical Abuse (PA), Emotional Abuse (EA), Sexual Abuse (SA), Physical Neglect (PN), Emotional Neglect (EN), and Minimization and Denial (MD). Component loadings for these items can be seen in Table 4. As the name suggests, the self-esteem is negatively correlated with childhood trauma and depression, which are positively correlated.

High scores on the ISES were positively correlated with high scores on the contingent self-esteem and devaluing items of the PNI as well as high scores on the BDI within the third component. However, RSES and SCC scores were negatively correlated, supporting the hypothesis that low self-esteem is associated with an instable and unclear self-concept. This component was termed the Low-Esteem Instable Self for that reason. Component loadings can be seen in Table 5.

Component four was mostly centred around self-consciousness in the public domain, as the public and social items of the SCS were correlated positively within it. Subscales of the SCS were taken from Scheier and Carver (2013) and included the Private subscale (SCS_Private) which measures introspection of the inner self, Public subscale (SCS_Public) which measures introspection about one's public self, and the Social subscale (SCS_Social) which measures

Table 3

Component 1: Narcissistic Self

	Component Loadings
PNI_Total	.912
PNI_ER	.805
PNI_GF	.707
PNI_DEV	.664
PNI_HS	.429
PNI_SSE	.844
PNI_EXP	.873
PNI_CSE	.629

Note. Only loadings > .4 included.

Table 4

Component 2: Trauma-Affected Self

	Component Loadings
RSES_Total	-.466
CTQ_EA	.852
CTQ_PA	.876
CTA_SA	.754
CTQ_EN	.505
CTQ_PN	.635
CTQ_Total	.943
BDI	.445

Note. Only loadings > .4 included.

Table 5

Component 3: Low-Esteem Instable Self

	Component Loadings
ISES_Total	.818
RSES_Total	-.710
SCC_Total	-.735
PNI_CSE	.603
PNI_DEV	.509
BDI	.610

Note. Loadings > .4 were included.

social anxiety. CTQ_MD correlated negatively in this component, indicating that self-consciousness in social situations is inversely related to minimization and denial of childhood trauma. Component loadings are shown in Table 6.

Component five was termed Neglected Hidden Self because it showed high positive correlations with items on the Hiding Self subscale of the PNI, the Emotional and Physical Neglect items on the CTQ, and a negative correlation with Minimization and Denial items on the CTQ. Component loadings are shown in Table 7. This was interpreted to mean that neglect during childhood is associated with inability/unwillingness to expose one's true self, and a lower chance that individuals might underreport trauma.

Component six, termed Grandiose Self, found a high positive correlation with higher scores on the SCS_Private and moderate positive correlations with high overall self-consciousness scores (SCS_Total) as well as higher scores on the Grandiose Fantasy subscale of the PNI. This indicates that high introspection of the inner self is associated with overall self-consciousness as well as a tendency to engage in compensatory aggrandizing fantasies (i.e. fantasizing about being acknowledged for some accomplishments etc.). The component loadings are displayed in Table 8.

Overall, the PCA confirmed trends found in the literature, which shall be discussed in the discussion section.

Trajectory Variables and Psychological Scales

To see if underlying constructs are associated with trends in evaluation trajectory, a correlational analysis was run. Distance was negatively correlated with RSES scores ($r(26) = -.438$, $p < .05$) and SCC scores ($r(26) = -.402$, $p < .05$), showing a moderately strong relationship

Table 6

Component 4: Conscious Self

	Component Loadings
SCS_Public	.788
SCS_Social	.649
SCS_Total	.748
CTQ_MD	-.557

Note. Loadings > .4 were included.

Table 7

Component 5: Neglected Hidden Self

	Component Loadings
PNI_HS	.770
CTQ_EN	.603
CTQ_PN	.595
CTQ_MD	-.643

Note. Loadings > .4 were included.

Table 8

Component 6: Grandiose Self

	Component Loadings
SCS_Private	.854
SCS_Total	.448
PNI_GF	.495

Note. Loadings > .4 were included.

between distance from the centre (a measure of negative sentiment) and lower self-esteem and self-concept clarity. Distance was positively correlated with CTQ_EA scores ($r(25) = .497$, $p < .05$), indicating and strong relationship between childhood emotional abuse and greater negative sentiment. Velocity was positively correlated with CTQ_PA scores ($r(25) = .487$, $p < .05$), CTQ_PN scores ($r(25) = .625$, $p < .001$), total CTQ scores ($r(25) = .455$, $p < .05$), and BDI scores ($r(26) = .389$, $p < .05$). This result shows a strong relationship between higher rate of change in cursor position, higher childhood trauma scores and a moderately strong relationship between higher rate of change in cursor position and higher depression scores. The position variable had no significant correlations, indicating that the changes in cursor position were unaffected by psychological constructs.

Discussion

This study partially supported the hypotheses adapted from Vallacher, Nowak, Froehlich and Rockloff (2002). There were no differences observed in the trajectory variables when data was analyzed by time period, suggesting that putative attractor states did not have a strong effect on the dynamics of participant evaluations. Ackerman and Kanfer (2009) found that participant fatigue and motivation was related to task length, which could impact performance. A reason for the lack of significance could be participant fatigue, as the present study had a more cognitively taxing paradigm than the original. In the original study the narratives recorded ranged from 1 ½ minutes to 5 minutes while the length of the narratives in the present study were all around 8 minutes. Furthermore, the present study included four 8-minute tasks under EEG conditions instead of just one.

Recall that correlational analysis found that self-esteem was found to impact affective judgements (as measured by the distance variable), which supports the hypothesis that low self-esteem is related to feelings of negativity about the self. This result supports the findings in the study by Vallacher, Nowak, Froelich and Rockloff (2002). The analysis also found a correlation between the distance variable and low scores on the SCC scale and high scores on the items on the CTQ_EA, which indicates that a low understanding of the self (unclear self) and low self-esteem are not only related but that they are negatively affected by childhood emotional abuse. Research on childhood abuse and its emergent psychopathology (Finzi-Dottan & Karu, 2006) found that emotional abuse had a detrimental effect on self-representation. The hypothesized parallel between self-concept clarity and self-structure stability and coherence seems to be supported in these results as well as the results from the PCA. Importantly, the third principal component (Low Self-Esteem Instable Self) unveiled the relationship between the RSES, ISES,

SCC scale, BDI, PNI_CSE, and PNI_DEV, accounting for the missing links in the correlational analysis between the trajectory variables and psychological constructs. An instable (high ISES scores) and unclear self (low SCC scores) were related to self-esteem being contingent on perceptions of social judgement (high PNI_CSE scores), and disinterest in others who do not provide admiration (high PNI_DEV scores). This makes intuitive sense when considering that individuals with instable self-structures are hypothesized to have their self-perception more heavily affected by outsider input. Placing higher value on outsider feedback could be a compensatory mechanism for a pre-existing low self-esteem. Pincus and Ansell (2009) found that scoring high on the PNI was associated with lower self-esteem, which is in line with the results of the current study, at least for the items mentioned above. The BDI loading onto this component suggests that negative attitudes towards oneself are associated with lower self-esteem. Practical implications for this data can be gathered by looking at research on the interdependency between quality of life, self-esteem and depression (Kuehner & Buerger, 2005), which finds that quality of life and self-esteem suffers as depressive symptoms increase.

The velocity variable (rate of change in cursor position) was found to be independent of distance and position, indicating that increased dynamism of the trajectory was not associated with any trends in judgement affect nor variability in self-evaluation. Positive correlations between the velocity variable and the CTQ_PA, CTQ_PN, CTQ_Total, and BDI suggest that rate of change in cursor position was higher for those who experienced some level of childhood mistreatment (especially physical abuse and neglect) and who had a negative attitude towards themselves. As the velocity variable was not associated with the ISES scale, the hypothesis that self-concept instability is related to erratic changes in self-evaluation was rejected. The PCA generated a principal component, termed the Trauma-Affected Self, which revealed a

relationship between the presence of childhood trauma (CTQ_EA, CTQ_PA, CTQ_SA, CTQ_EN, CTQ_PN, and CTQ_Total), low self-esteem, and depressive symptoms. The link between childhood trauma and mood disorders such as depression has already been briefly discussed but can be further supplemented by neurological research on the role of early life trauma in modulating neuroplastic mechanisms leading to increased vulnerability to mental illness (Catteneo et al., 2015). Thome et al., (2018) found that psychological trauma had an impact on cognitive processes via fear conditioning, resulting in anticipation of aversive stimuli even in a non-threatening environment. Thome et al. also found that traumatized individuals reacted faster when ambiguous stimuli were presented, suggesting that fear overgeneralization decreased their cognitive load during decision making. It could be the case that the correlation between velocity and childhood trauma observed in the current study is based on the same principal, wherein fear-conditioned individuals have more rapid cursor movements, though the only "aversive" stimuli would have been nested within the participant narratives themselves. However, there is contradicting evidence on reaction speed in research with depressed patients, which finds that cognitive processing speed is dampened by the presence of depressive symptoms (Albert, Potter, McQuoid, & Taylor (2018), so the association between velocity and higher scores on the BDI could negate the former explanation.

The position variable had no significant correlations with any of the psychological measures, which contradicts the hypothesis that self-concept uncertainty was related to increased variability in self-evaluation. It was, however, correlated with the overall distance scores, which indicates that these two measures were dependent on each other to some degree. These results suggest that the position variable may not have been a valid measure of variability. Repeating

this method by calculating the magnitude and number of position changes could give more informative data on the variability in evaluation.

The component called Narcissistic Self provided validity for the PNI, while the component called the Conscious Self supported the validity for the SCS, as all items of both scales were correlated within their respective components. Interestingly, component six (Grandiose Self) found a relationship between SCS_private, SCS_total, and PNI_GF scores. This result suggests that high introspection of the inner self was associated with overall self-consciousness as well as engagement in compensatory fantasies about accomplishments and social appraisal. The relationship between grandiose fantasy and introspection of the inner self and self-consciousness could be explained by an urge to present oneself as "perfect" (Casale, Fioravanti, Rugai, Flett, & Hewitt, 2016) or by a multitude of overlapping psychological domains. For example, it could be the case that self-reflectiveness is an unhealthy aspect of private self-consciousness that is related to a lack of understanding of oneself (Conway, Giannopoulos, Ciank, & Mendelson, 1993).

Component five, called Hidden Self, found a relationship between high scores on the PNI_HS, CTQ_EN, CTQ_PN, and low scores on the CTQ_MD. Grandiose narcissism had been associated with perfectionist self-presentation with the intention of deflecting attention away from personal inadequacies (Conway, Giannopoulos, Ciank, & Mendelson, 1993), which could suggest that the hiding of the self is a part of this overcompensation mechanism. The CTQ items correlating with the rest of the psychological measures within this component could suggest that individuals who were faced with some level of childhood neglect are compelled to hide the self in adulthood. This interpretation is supported by research on the role of childhood mistreatment in the origins of perfectionism (Ko, Hewitt, Cox, Flett, & Chen, 2019), which showed that

adverse parenting was related to perceived defectiveness and aspects of perfectionism. The CTQ_MD is a measure for estimating the tendency to underreport trauma, and the negative correlation of this subscale with the aforementioned measures indicates that minimization and denial of trauma is inversely related to this grouping of responses. It could be argued that childhood neglect is used to mask any personal failings as those caused by a poor upbringing, although this assumption does not have any literature behind it.

Analyzing trajectory variables in the self versus other narrative ownership condition showed that affective tone (measured by the distance variable) differed significantly. Upon closer examination, participants tended to rate themselves more negatively (higher mean distance) than they did the other narrative. Epley, Gilovich and Savitsky (2001) found that social judgement for blunders and failings was less condemning than participants assumed they would be, and that overly pessimistic expectations were rooted in a cynical intuition of human judgement. Additionally, the researchers theorized that if it is the case that individuals have this assumption, it is likely that they would apply an equivalent level of judgement upon their own successes and failures, which this study supports. It could also be the case that because a number of the participants were familiar with the principal investigators who conducted the study (myself and my colleagues), that their judgements were less harsh. Taylor and Koivumaki (1976) conducted a study which found a positivity effect for perceptions of those with whom participants had a closer relationship, indicating that the results from the present study could have been biased by acquaintanceship and friendship.

There were no differences found in the variables position and velocity between the self and other narrative ownership conditions, which could suggest that these behavioural measures are not subject to change based on selfhood. In other words, it could be the case that dynamism

and variability in evaluation are core mediators of evaluation style and do not shift based on subject matter (selfhood versus otherness).

Studies analyzing self-related processes conventionally use static methods such as comparing means and finding correlations. Classically, self-esteem is conceived as a static global trait operating on a macro time scale (life-long) whereas self-evaluation is treated as an unstable and shifting process confined to shorter and more fluctuating micro time scale (day-to-day) (Rosenberg, 1986). While this view affords a more convenient perspective on self-esteem, the stability of self-esteem as a trait should not be treated in such a fixed way (Wong, Vallacher, & Nowak, 2014). Previous research by Delignières, Fortes, and Ninot (2004) found that fractal dynamics were present in self-esteem fluctuations sampled twice daily across five hundred days. The presence of 1/*f* noise in their results led them to conclude that self-esteem variability was part of a complex self-similar structure intertwined across many time scales. The fractal temporal structure of their results showed that fluctuations in self-esteem on macro scales were statistically identical to fluctuations on micro scales, which means simply that self-esteem as a trait and self-evaluation as a process are qualitatively equivalent patterns with shared dynamical underpinnings. In light of this research, the present analyses sought to include a dynamic approach, which found a pattern of self-similarity wherein the power was inversely proportional to the frequency in timeseries data (1/*f),* in accordance with the fractal temporal structure of self-evaluation as observed by Delignières, Fortes, and Ninot (2004) as well as Wong, Vallacher, and Nowak (2014).

In conclusion, self-evaluation is a dynamic process that can be equivalated to the emergent global self-esteem trait in the long term. It is influenced by a multitude of overlapping psychological underpinnings which in some cases are associated with one another. This finding

provides a foundation for future directions when it comes to analyzing and conceptualizing self-esteem. Self-evaluation time series data could be compared to neurobiological data seeing as they have a similar scale-free dynamic, as I intend to do. It could also be compared to a greater range of psychological measures (questionnaires) to unearth the influences of life events on self-structure. Trends in self-evaluation can also be informative to mental health professionals in assessing their patients' self-esteem, as these micro and macro constructs are self-similar.

Comparisons between selfhood and otherness marked the presence of a common fallacy in beliefs about social judgement. The influence of otherhood on the self is nascent in the inequality between harshness of judgements between the narrative ownership conditions. In this way, it could be said that the self is judged by the perceived criteria of the other, which raises many potential future directions for study on social judgement. For example, incorporating an opportunity for explanation of the judgements could give researchers insight on judgement criteria pervasive among the participants. From there, fairness of judgements levelled at the self versus the other could be disambiguated. The analysis of trajectory produces the same conclusions that were posited by Jung and Cooley, that otherness is an inextricable factor in defining the self.

References

Ackerman, P. L., & Kanfer, R. (2009). Test length and cognitive fatigue: An empirical examination of effects on performance and test-taker reactions. *Journal of Experimental Psychology: Applied, 15*(2), 163-181. doi: 10.1037/a0015719

Bernstein, D. P., Fink, L., Handelsman, L., & Foote, J. (1994). Childhood Trauma Questionnaire. *PsycTESTS Dataset*. doi:10.1037/t02080-000

Campbell, J. D., Trapnell, P. D., Heine, S. J., Katz, I. M., Lavallee, L. F., & Lehman, D. R. (1996). Self-concept clarity: Measurement, personality correlates, and cultural boundaries. *Journal of Personality and Social Psychology, 70*(1), 141-156.

Casale, S., Fioravanti, G., Rugai, L., Flett, G. L., & Hewitt, P. L. (2016). The interpersonal expression of perfectionism among grandiose and vulnerable narcissists: Perfectionistic self-presentation, effortless perfection, and the ability to seem perfect. *Personality and Individual Differences, 99*, 320-324. doi: 10.1016/j.paid.2016.05.026

Cattaneo, A., Macchi, F., Plazzotta, G., Veronica, B., Bocchio-Chiavetto, L., Riva, M. A., & Pariante, C. M. (2015). Inflammation and neuronal plasticity: A link between childhood trauma and depression pathogenesis. *Frontiers in Cellular Neuroscience, 9*, 40. doi: 10.3389/fncel.2015.00040

Cheek, J. M., & Melchior, L. A. (1990). *Shyness, self-esteem, and self-consciousness.* In H. Leitenberg (Ed.), *Handbook of social and evaluation anxiety* (p. 47–82). Plenum Press. https://doi.org/10.1007/978-1-4899-2504-6_3

Conway, M., Giannopoulos, C., Ciank, P., Mendelson, M. (1993). Dysphoria and specificity in self-focused attention. *Society for Personality and Social Psychology, 19*(3), 265-268. doi: 10.1177/0146167293193002

Delignières, D., Fortes, M., Ninot, G. (2004). The fractal dynamics of self-esteem and physical self. *Nonlinear Dynamics of Psychology and Life Sciences, 8*(4), 479-510.

Epley, N., Gilovich, T., & Savitsky, K. (2001). Do others judge us as harshly as we think? Overestimating the impact of our failures, shortcomings, and mishaps. *Journal of Personality and Social Psychology, 81*(1), 44-56. doi: 10.1037//0022-3514.81.1.44

Fenigstein, A., Scheier, M. F., and Buss, A. H. (1975). Public and private self-consciousness: assessment and theory. *J. Consult. Clin. Psychol.* 36, 1241–1250. doi: 10.1037/h0076760

Finzi-Dottan, R., & Karu, T. (2006). From emotional abuse in childhood to psychopathology in adulthood: a path mediated by immature defense mechanisms and self-esteem. *Journal of Nervous and Mental Disease, 194*(8), 616-621. doi: 10.1097/01.nmd.0000230654.49933.23

Gallagher, S. 2000. Philosophical Conceptions of the Self: Implications for Cognitive Science. *Trends in Cognitive Sciences* 4(1): 14–21.

Gallagher, S., & D. Zahavi. 2012. *The Phenomenological Mind*, 2nd ed. New York: Routledge.

Heim, C., Newport, D. J., Mletzko, T., Miller, A. H., & Nemeroff, C. B. (2008). The link between childhood trauma and depression: Insights from HPA axis studies in humans. *Psychoneuroendocrinology, 33*(6), 693-710. doi:10.1016/j.psyneuen.2008.03.008

IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Jones, J. H. (2018, February 19). Time Series and Spectral Analysis. Retrieved August 22, 2020, from http://web.stanford.edu/class/earthsys214/notes/series.html

Ko, A., Hewitt, P. L., Cox, D., Flett, G. L., Chen, C. (2019). Adverse parenting and perfectionism: A test of the mediating effects of attachment anxiety, attachment avoidance, and perceived defectiveness. *Personality and Individual Differences, 150*. doi: 10.016/j.paid.2019.06.017

Kolvoort, I. R., Wainio-Theberge, S., Wolff, A., Northoff, G. (2020). Temporal integration as "common currency" of brain and self-scale-free activity in resting-state EEG correlates with temporal delay effects on self-relatedness. *Human Brain Mapping*. doi: 10.1002/hbm.25129

MATLAB. (2010). *version 7.10.0 (R2010a)*. Natick, Massachusetts: The MathWorks Inc.

Miller, P. (2016). Dynamical systems, attractors, and neural circuits. *F1000Research, 5*, 992. doi:10.12688/f1000research.7698.1

Nnadozie, J. C. (2017). Self Esteem, Social Support And Postpartum Depression. *Journal of International Social Research, 10*(51), 551-556. doi:10.17719/jisr.2017.1789

Pincus, A. L. (2013). The Pathological Narcissism Inventory. *Understanding and Treating Pathological Narcissism.,* 93-110. doi:10.1037/14041-006

Rosenberg, M. (1965). *Society and the adolescent self-image.* Revised edition. Middletown, CT: Wesleyan University Press.

Rosenberg, M. (1986). *Conceiving the self*. Malabr, FL: Krieger.

Sharp-Davidson, D. (2015). *Self-structure and discrimination: Implications for coping and wellbeing* (Unpublished PHD thesis). Australian National University.

Scheier, M.F., & Carver, C. S., (2013). Self-Consciousness Scale—(SCS_R). Measurement Instrument Database for the Social Science. Retrieved from www.midss.ie

Steer, R. A., Beck, A. T., & Garrison, B. (1986). Applications of the Beck Depression Inventory. *Assessment of Depression,* 123-142. doi:10.1007/978-3-642-70486-4_13

Taylor, S. E., & Koivumaki, J. H. (1976). The perception of self and others: Acquaintanceship, affect, and actor-observer differences. *Journal of Personality and Social Psychology, 33*(4), 403-408. doi: 10.1037/0022-3414.33.4.403

The Jamovi project (2020). *Jamovi* (Version 1.2) [Computer Software]. Retrieved from https://www.jamovi.org

Thome, J., Hauschild, S., Koppe, G., Liebke, L., Rausch, S., Herzog, J. I., Müller-Engelmann, M., Steil, R., Priebe, K., Hermans, D., Schmahl, C., Bohus, M., & Lis, S. (2018). Generalisation of fear in PTSD related to prolonged childhood maltreatment: An experimental study. *Psychological Medicine, 48*(13), 2223-2234. doi: 10.1017/S0033291717003713

Vallacher, R. R., Nowak, A., Froehlich, M., & Rockloff, M. (2002). The Dynamics of Self-Evaluation. *Personality and Social Psychology Review, 6*(4), 370-379. doi:10.1207/s15327957pspr0604_11

Wong, A. E., Vallacher, R. R., Nowak, A. (2014). Fractal Dynamics in Self-Evaluation Reveal Self-Concept Clarity. *Society for Chaos Theory in Psychology & Life Sciences*, *18*(4), 349-369. doi: 10.1207/S15327957PSPR0604_11

123apps LLC (2012-2020). Voice Recorder [web application software]. Retrieved from https://online-voice-recorder.com/

Appendix A

Rosenberg Self Esteem Scale (Rosenberg, 1965)

1. I feel that I am a person of worth, at least on an equal plane with others

1 (Not at all like me) 2 3 4 5 (Very much like me)

2. I feel that I have a number of good qualities…

1 (Not at all like me) 2 3 4 5 (Very much like me)

3. All in all, I am inclined to feel that I am a failure

1 (Not at all like me) 2 3 4 5 (Very much like me)

4. I am able to do things as well as most other people

1 (Not at all like me) 2 3 4 5 (Very much like me)

5. I feel I do not have much to be proud of

1 (Not at all like me) 2 3 4 5 (Very much like me)

6. I take a positive attitude toward myself

1 (Not at all like me) 2 3 4 5 (Very much like me)

7. On the whole, I am satisfied with myself

1 (Not at all like me) 2 3 4 5 (Very much like me)

8. I wish I could have more respect for myself

1 (Not at all like me) 2 3 4 5 (Very much like me)

9. I certainly feel useless at times

1 (Not at all like me) 2 3 4 5 (Very much like me)

10. At times I think I am no good at all

1 (Not at all like me) 2 3 4 5 (Very much like me)

Appendix B

Beck's Depression Inventory (Steer, Beck, & Garrison, 1986)

1. Sadness
   - 0 I do not feel sad.
   - 1 I feel sad much of the time.
   - 2 I am sad all the time.
   - 3 I am so sad or unhappy that I can't stand it.

2. Pessimism
   - 0 I am not discouraged about my future.
   - 1 I feel more discouraged about my future than I used to be.
   - 2 I do not expect things to work out for me.
   - 3 I feel my future is hopeless and will only get worse.

3. Past Failure
   - 0 I do not feel like a failure.
   - 1 I have failed more than I should have.
   - 2 As I look back, I see a lot of failures.
   - 3 I feel I am a total failure as a person.

4. Loss of Pleasure
   - 0 I get as much pleasure as I ever did from the things I enjoy.
   - 1 I don't enjoy things as much as I used to.
   - 2 I get very little pleasure from the things I used to enjoy.
   - 3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings
   - 0 I don't feel particularly guilty.
   - 1 I feel guilty over many things I have done or should have done.
   - 2 I feel quite guilty most of the time.
   - 3 I feel guilty all of the time.

6. Punishment Feelings
   - 0 I don't feel I am being punished.
   - 1 I feel I may be punished.
   - 2 I expect to be punished.
   - 3 I feel I am being punished.

7. Self-Dislike
   - 0 I feel the same about myself as ever.
   - 1 I have lost confidence in myself.
   - 2 I am disappointed in myself.
   - 3 I dislike myself.

8. Self-Criticalness
   0 I don't criticize or blame myself more than usual.
   1 I am more critical of myself than I used to be.
   2 I criticize myself for all of my faults.
   3 I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes
   0 I don't have any thoughts of killing myself.
   1 I Have thoughts of killing myself, but I would not carry them out.
   2 I would like to kill myself.
   3 I would kill myself if I had the chance

10. Crying
   0 I don't cry any more than I used to.
   1 I cry more than I used to.
   2 I cry over every little thing.
   3 I feel like crying, but I can't.

11. Agitation
   0 I am no more restless or wound up than usual.
   1 I feel more restless or wound up than usual.
   2 I am so restless or agitated that it's hard to stay still.
   3 I am so restless or agitated that I Have to keep moving or doing something.

12. Loss of Interest
   0 I have not lost interest in other people or activities.
   1 I am less interested in other people or things than before.
   2 I have lost most of my interest in other people or things.
   3 It's hard to get interested in anything.

13. Indecisiveness
   0 I make decisions about as well as ever.
   1 I fint it more difficult to make decisions than usual.
   2 I have much greater difficult in making decisions than I used to.
   3 I have trouble making any decisions.

14. Worthlessness
   0 I do not feel I am worthless.
   1 I don't consider myself as worthwhile and useful as I used to.
   2 I feel more worthless as compared to other people.
   3 I feel utterly worthless.

15. Loss of Energy
   0 I have as much energy as ever.
   1 I have less energy than I used to have.

2 I don't have enough energy to do very much.
3 I don't have enough energy to do anything.

16. Changes in Sleeping Pattern
    0 I have not experienced any change in my sleeping pattern.
    1a I sleep somewhat more than usual.
    1b I sleep somewhat less than usual.
    2a I sleep a lot more than usual.
    2b I sleep a lot less than usual.
    3a I sleep most of the day.
    3b I wake up 1-2 hours early and can't get back to sleep.

17. Irritability
    0 I am no more irritable than usual.
    1 I am more irritable than usual.
    2 I am much more irritable than usual.
    3 I am irritable all the time.

18. Changes in Appetite
    0 I have not experienced any change in my appetite.
    1a My appetite is somewhat less than unusual.
    1b My appetite is somewhat greater than usual.
    2a My appetite is much less than before.
    2b My appetite is much greater than usual.
    3a I have no appetite at all.
    3b I crave food all the time.

19. Concentration Difficulty
    0 I can concentrate as well as ever.
    1 I can't concentrate as well as usual.
    2 It's hard to keep my mind on anything for very long.
    3 I find I can't concentrate on anything.

20. Tiredness or Fatigue
    0 I am no more tired or fatigued than usual.
    1 I get more tired or fatigued more easily than usual.
    2 I am too tired or fatigued to do a lot of the things I used to do.
    3 I am too tired or fatigues to do most of the things I used to do.

21. Loss of Interest in Sex
    0 I have not noticed any recent change in my interest in sex.
    1 I am less interested in sex than I used to be.
    2 I am much less interested in sex now.
    3 I have lost interest in sex completely.

Appendix C

Childhood Trauma Questionnaire (Bernstein, Fink, Handelsman, & Foote, 1994)

1. I didn't have enough to eat

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

2. I knew there was someone to take care of me and protect me

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

3. People in my family called me things like "stupid", "lazy", or "ugly"

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

4. My parents were too drunk or high to take care of the family.

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

5. There was someone in my family who helped me feel important or special.

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

6. I had to wear dirty clothes

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

7. I felt loved

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

8. I thought that my parents wished I had never been born

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

9. I got hit so hard by someone in my family that I had to see a doctor or go to the hospital

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

10. There was nothing I wanted to change about my family

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

11. People in my family hit me so hard that it left me with bruises or marks

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

12. I was punished with a belt, a board, a cord, or some other hard object

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

13. People in my family said hurtful or insulting things to me

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

14. People in my family said hurtful or insulting things to me

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

15. I believe that I was physically abused

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

16. I had the perfect childhood

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

17. I got hit or beaten so badly that it was noticed by someone like a teacher, neighbor, or doctor

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

18. I felt that someone in my family hated me

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

19. People in my family felt close to each other

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

20. Someone tried to touch me in a sexual way, or tried to make me touch them

1 (Never true) 2 (rarely true) 3 (sometimes true) 4 (often true) 5 (Very often true)

21. Someone threatened to hurt me or tell lies about me unless I did something sexual with them

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

22. I had the best family in the world

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

23. Someone tried to make me do sexual things or watch sexual things

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

24. Someone molested me

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

25. I believe that I was emotionally abused

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

26. There was someone to take me to the doctor is I needed it

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

27. I believe that I was sexually abused

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

28. My family was a source of strength and support

1 (Never true)	2 (rarely true)	3 (sometimes true)	4 (often true)	5 (Very often true)

Appendix D

Pathological Narcissism Inventory (Pincus, 2013)

1. I often fantasize about being admired and respected.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

2. My self-esteem fluctuates a lot.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

3. I sometimes feel ashamed about my expectations of others when they disappoint me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

4. I can usually talk my way out of anything.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

5. It's hard to feel good about myself when I'm alone.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

6. I can make myself feel good by caring for others.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

7. I hate asking for help.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

8. When people don't notice me, I start to feel bad about myself.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

9. I often hide my needs for fear that others will see me as needy and dependent.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

10. I can make anyone believe anything I want them to.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

11. I get mad when people don't notice all that I do for them.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

12. I get annoyed by people who are not interested in what I say or do.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

13. I wouldn't disclose all my intimate thoughts and feelings to someone I didn't admire.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

14. I often fantasize about having a huge impact on the world around me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

15. I find it easy to manipulate people.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

16. When others don't notice me, I start to feel worthless.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

17. Sometimes I avoid people because I'm concerned that they'll disappoint me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

18. I typically get very angry when I'm unable to get what I want from others.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

19. I sometimes need important others in my life to reassure me of my self-worth.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

20. When I do things for other people, I expect them to do things for me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

21. When others don't meet my expectations, I often feel ashamed about what I wanted.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

22. I feel important when others rely on me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

23. I can read people like a book.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

24. When others disappoint me, I often get angry at myself.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

25. Sacrificing for others makes me the better person.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

26. I often fantasize about accomplishing things that are probably beyond my means.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

27. Sometimes I avoid people because I'm afraid they won't do what I want them to.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

28. It's hard to show others the weaknesses I fell inside.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

29. I get angry when criticized.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

30. It's hard to feel good about myself unless I know other people admire me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

31. I often fantasize about being rewarded for my efforts.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

32. I am preoccupied with thoughts and concerns that most people are not interested in me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

33. I like to have friends who rely on me because it makes me feel important.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

34. Sometimes I avoid people because I'm concerned they won't acknowledge what I do for them.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

35. Everybody likes to hear my stories.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

36. It's hard for me to feel good about myself unless I know other people like me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

37. It irritates me when people don't notice how good a person I am.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

38. I will never be satisfied until I get all that I deserve.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

39. I try to show what a good person I am through my sacrifices.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

40. I am disappointed when people don't notice me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

41. I often find myself envying others' accomplishments.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

42. I often fantasize about performing heroic deeds.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

43. I help others in order to prove I'm a good person.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

44. It's important to show people I can do it on my own, even if I have some doubts inside.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

45. I often fantasize about being recognized for my accomplishments.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

46. I can't stand relying on other people because it makes me feel weak.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

47. When others don't respond to me the way that I would like them to, it is hard for me to still feel ok with myself.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

48. I need others to acknowledge me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

49. I want to amount to something in the eyes of the world.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

50. When others get a glimpse of my needs, I feel anxious and ashamed.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

51. Sometimes it's easier to be alone than to face not getting everything I want from other people.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

52. I can get pretty angry when others disagree with me.

0 (not like me at all) 1 2 3 4 5 6 (very much like me)

Appendix E

Self-Concept Clarity Scale (Campbell et al, 1996)

1. My beliefs about myself often conflict with one another.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

2. On one day I might have one opinion of myself and on another day I might have a different opinion.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

3. I spend a lot of time wondering about what kind of person I really am.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

4. Sometimes I feel that I am not really the person that I appear to be.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

5. When I think about the kind of person I have been in the past, I'm not sure what I was really like.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

6. I seldom experience conflict between the different aspects of my personality.

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

7. Sometimes I think I know other people better than I know myself. *

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

8. My beliefs about myself seem to change very frequently.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

9. If I were asked to describe my personality, my description might end up being different from one day to another day.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

10. Even if I wanted to, I don't think I could tell someone what I'm really like.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

11. In general, I have a clear sense of who I am and what I am.

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

12. It is often hard for me to make up my mind about things because I don't really know what I want.*

1 (Strongly Disagree) 2 3 4 5 (Strongly Agree)

Appendix F

Rosenberg Instability of Self Items (Rosenberg, 1965)

1. Sometimes I feel worthless; at other times I feel that I am worthwhile

1 (Not at all like me) 2 3 4 5 (Very much like me)

2. Sometimes I feel happy with myself; at other times I feel very unhappy with myself

1 (Not at all like me) 2 3 4 5 (Very much like me)

13. Sometimes I feel useless; at other times I feel very useful

1 (Not at all like me) 2 3 4 5 (Very much like me)

14. Sometimes I feel very bad about myself; at other times I feel very good about myself

1 (Not at all like me) 2 3 4 5 (Very much like me)

Appendix G

Self-Consciousness Scale-Revised (Fenigstein, Scheier, & Buss, 1975)

Items	0	1	2	3
I'm always trying to figure myself out.				
I'm concerned about my style of doing things.				
It takes me times to get over my shyness in new situations.				
I think about myself a lot.				
I care a lot about how I present myself to others.				
I often daydream about myself.				
It's hard for me to work when someone is watching me.				
I never take a hard look at myself.				
I get embarrassed very easily.				
I'm self-conscious about the way I look.				
It's easy for me to talk to strangers.				
I generally pay attention to my inner feelings.				
I usually worry about making a good impression.				
I'm constantly thinking about my reasons for doing things.				
I feel nervous when I speak in front of a group.				
Before I leave my house, I check how I look.				
I sometimes step back (in my mind) in order to examine myself from a distance				
I'm concerned about what other people think of me.				
I'm quick to notice changes in my mood.				
I'm usually aware of my appearance.				
I know the way my mind works when I work through a problem.				
Large groups make me nervous				

Appendix H

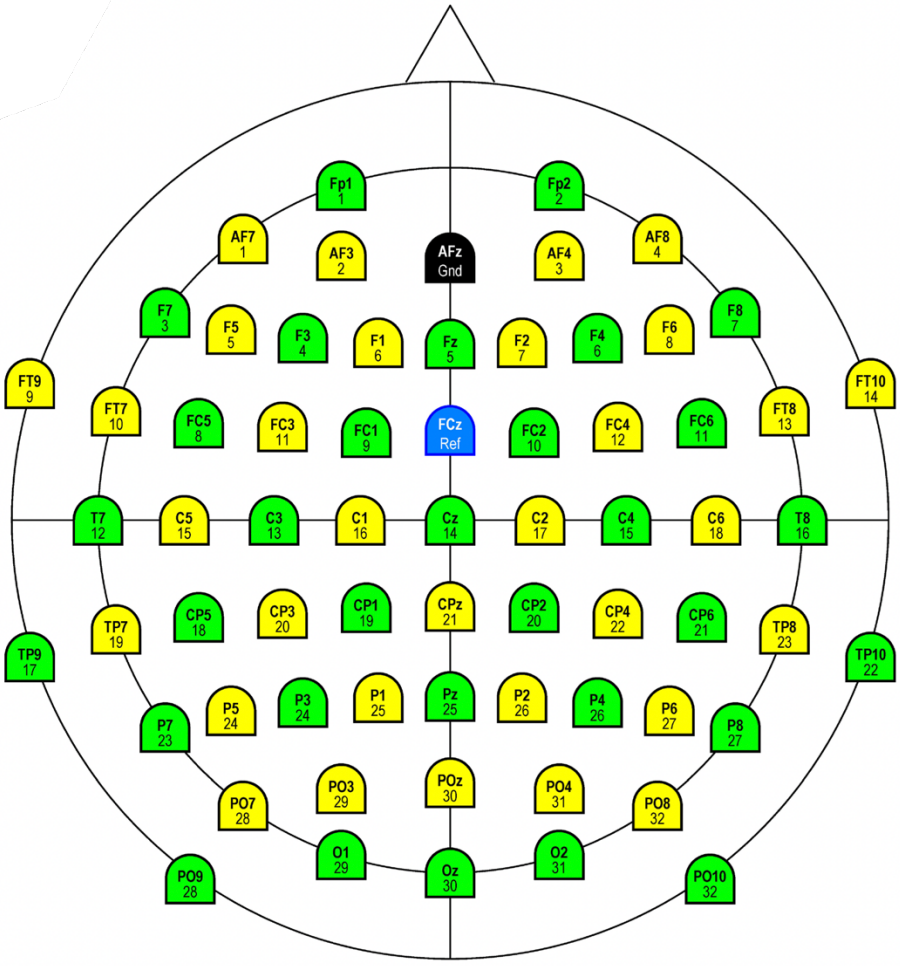
Electrode Placements

actiCAP 64Ch Standard-2

Green holders: electrode positions Ch1 – Ch32 Yellow holders: Label 1-32, hard-wired Ch33 – Ch64 Blue holder: Ref
Black holder: Gnd

Components:

- Softcap, white
- Holders with flat side inwards
- 3 additional holders (white, empty label) for use with double-sided adhesive rings to place electrodes on bare skin
- 1 chin belt
- this layout / pinout



Appendix I

Consent Form

Informed Consent Form for Study Participants

Title of Protocol: "The Fractal dynamics of the Self"

Principal Investigators: **Julia Ignaszewski**

Participant Name: _____

I, _____, have read the preceding information and have had a chance to ask questions to help me understand what my participation will involve. My signature below indicates that the study and related procedures have been explained to me and that I freely give my consent to participate in the study unless I decide otherwise. I will receive a signed copy of this consent form.

_____	_____	_____
Participant (Print Name)	Signature	Date
_____	_____	_____
Person Obtaining Consent	Signature	Date

(Print Name)

Investigator Statement

I certify that I have explained the research study to the above individual, including the purpose, the procedures, the possible risks and potential benefits associated with participation in this research study. Any questions raised have been answered to the individual's satisfaction. I believe that the participant fully understands my explanations and has freely given informed consent.

_____	_____	_____
Investigator (Print Name)	Signature	Date

Appendix J

Demographic Health Questionnaire

1. Have you ever been diagnosed with a mental illness or condition (ex. Depression, anxiety, posttraumatic stress disorder, etc.)? _____
   If yes, which illness and when? _____
2. Have you ever been diagnosed with a neurological condition (ex. Epilepsy, stroke, dementia, etc.)? _____
   If yes, which condition and when? _____
3. Have you ever had a head injury that was treated by a doctor?_____
4. Have you ever been knocked unconscious for more than 5 minutes? _____
5. In the past 3 months have you used alcohol or drugs in a way that caused you to take risks, neglected your responsibilities, or caused problems in your relationships with friends or family? _____
6. Have you ever used alcohol or drugs in a way that you knew was hurting you, where you needed more of it to get the same feeling, or used it to make yourself feel better physically or mentally? _____
7. Have you ever been treated with chemotherapy, radiation therapy to your brain or electroconvulsive therapy (ECT)? _____
8. Are you currently taking any medication prescribed by a doctor?
   If yes, which medication? _____
9. Are you below the age of 18? _____
10. Do you need glasses to read? _____
    If so, do you have them with you today? _____
11. In the last 7 days, have you smoked cigarettes on a regular basis? _____
12. In the last 7 days, have you smoked cigarettes or ingested marijuana? _____
13. In the last 7 days, have you taken any other medication not listed above (ex. Advil, Tylenol, Tylenol-3, multivitamin, etc)? _____
    If yes, which medication? _____
14. What is your approximate height? _____
15. What is your approximate weight? _____

16. Sex _____
17. Highest education _____
18. When did you last eat (in hours)? _____