Predicting the Daily Temperament of Any Human Using Two Dopamine Cycles

RUNNING HEADER: PREDICTING DAILY TEMPERAMENT

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A speculative essay, in the scientific tradition of ever more granular human behaviors falling into a reductionist paradigm, where, in addition to the previously established human behavioral patterns tracked to the annual sunlight-driven dopamine cycle, a second dopamine "clock" or cycle is proposed in the human brain. This measured cycle occurs starts with a 10-day-long "low dopamine" phase (with various stages of impulsivity, anxiety, and depression and then the reverse as dopamine levels climb back up), then a 10-day-long "high dopamine" phase (with hyperactive and manic behaviors), before diminishing to a 20-day-long "normal dopamine" phase (with calm and focus), before the cycle starts again with the "low dopamine" phase. The levels of the primary sunlight-driven cycle and the proposed secondary dopamine cycle aggregated together are considered as the only factors needed to create a calendar map of "human temperament." There are nine 40-day-long cycles in the calendar year with the cycles occurring on the same days every year.

The data that supports the findings of this study are available from the corresponding author upon reasonable request. The author has no conflict of interest to declare, and no funding source is associated with this work.

Predicting the Daily Temperament of Any Human Using Two Dopamine Cycles

A model is proposed where, in addition to the previously established human behavioral patterns tracked to the annual sunlight-driven dopamine cycle (Figure 1), a second dopamine "clock" is proposed in the human brain. This measured cycle starts with a 10-day-long "low dopamine" phase (with various stages of impulsivity, anxiety, and depression and then the reverse as dopamine levels climb back up), then a 10-day-long "high dopamine" phase (with hyperactive and manic behaviors), before diminishing to a 20-day-long "normal dopamine" phase (with calm and focus), before the cycle starts again with the "low dopamine" phase (Figure 2). There are nine 40-day-long cycles in the calendar year with the cycles occurring on the same days every year. The proposal intimates a sort of "universal cyclothymic disorder" where the vast majority of human beings share the same general temperament on any given day of the year that can be mapped and that is the same every year with an inherent and inverse difference between humans in the northern and southern hemispheres.

Methods

Over a period of three years, three adult males in their forties were tracked on a daily basis measuring subjective values of mood or temperament. The subjects included a bipolar individual with ADHD and a benign essential blepharospasm, an individual with only ADHD, and a control individual with none of these pre-existing conditions. Changes in medication, behaviors (exercise, focus, creativity, quality of sleep) and blepharospasm severity (in the bipolar subject) were monitored to attempt to isolate any possible reoccurring seasonal or annual patterns or cycles inherent in all humans (e.g., the proposed additional cyclic pattern of fluctuating dopamine levels) that could help explain behaviors in aggregate human populations.

A pattern was observed in all three subjects with the severity of the effects diminishing from the bipolar subject to the ADHD and the control subject. The observed pattern was of the noted drop and then spike and normal slope temperament function that had a reoccurring pattern of nine 40-day-long wavelength cycles year-over-year.

The observations in this informal study and prior literature were used to create a year-long calendar where the dopamine sinusoidal wave pattern (Maruani et al, 2018), tied to blue light from sunlight, was overlaid with the proposed secondary 40-day-long wavelength (Figure 3) to create an *aggregate map of human temperament* (Figure 4).

One premise driving this informal study was that the severity and reoccurring timing of blepharospasm events, of the bipolar subject, might reveal a subtle brain dopamine pattern via the regularity of blepharospasms triggered during decreasing dopamine intervals. This pattern would otherwise get “lost in the noise" of variations in mood from everyday life events and exogenous factors listed below as limitations to this work.

Note that benign essential blepharospasms (the uncontrollable eyelid blinking and facial dystonia or “motor tics” i.e., the blink system) are sensitive to central dopamine levels (Evinger, 2013). Dopamine depletion alone is also noted as a cause of blepharospasm (Evinger, 2013). Evinger (2013) also noted that “abnormalities in dopamine transmission may be a proximate cause of the predisposing condition that allows the development of benign essential blepharospasm.” Abnormalities in the basal ganglia dopamine system are also noted as leading to abnormal sensorimotor mappings manifest as blepharospasms (Peterson DA and Sejnowski TJ, 2017). Abnormal dopaminergic signaling in the striatum of the human brain could also induce pathological reinforcement learning and lead to blepharospasms (Peterson DA and Sejnowski TJ, 2017).

One possible cause of the proposed additional 40-day-long dopamine cycle is a possible lag in the adjustment in eye retina size to seasonal changes, i.e., the pupil size is incorrectly sized too large or too small (thus leading to excessive or diminished dopamine levels from blue light) until the lag is adjusted to the proper pupil size for the given time of year after 40 days. Murani et al (2018) noted that “retinal anomalies are apparent in Seasonal Affective Disorder during the depressive phase in autumn/winter” (pg. 11). Murani et al (2019) also note in their research that:

> The photoperiod also alters the balance of dopamine. Dopamine acts to regulate the sleep/wake cycle. Dopamine is also important to adaptation to the light/dark cycles in retina photoreceptors (pg. 11).

Also note that lack of sleep, like that caused by sleep apnea or poor circadian rhythm “clocking,” has been linked to poor impulse control and emotion dysregulation (McCarver-Reyes, 2019). McCarver-Reyes (2019) noted in their research that sleep deprivation was associated with “impaired response inhibition, risky decision-making, increased risk-seeking, attention deficit hyperactivity disorder (ADHD), gambling disorder symptoms, Internet addiction symptoms, and personality-related impulsiveness.” Dopamine via its involvement in the sleep process, as well as directly, can influence impulsive and hyperactive behaviors. Katherine Harmon wrote that “impulsivity has long been linked to the neurotransmitter dopamine, which is involved in learning and reward” (pg. 1) in her July 29, 2010, article in Scientific American titled *Dopamine Determines Impulsive Behavior: Brain scans illuminate the internal connection among the neurotransmitter, impulsiveness, and addiction*.

Limitations to the proposed model include the obvious small sample size leading to large assumptions and generalizations not backed by standard statistical regression analysis. Other limitations to the model include the lack of detailed tracking of many other factors that can influence human temperament and thus behavior.

The claim of the model is that only two dopamine associated cycles are needed to represent the vast majority of temperament of a given individual on a given day of the year which, at an individual level, may obviously not be accurate given the number of other known possible influences or factors. Those factors could include stress, travel, sleep apnea, low blood sugar (glucose) levels, cloudy or stormy days, medications for blood pressure, SSRIs, sedatives, stimulants, tranquilizers, alcohol, illegal drugs, daylight savings time interruptions to sleep, time of day, physical or psychological trauma, medical conditions like rapid-cycling bipolar disorder, and even oxytocin (i.e., emotional love) or “heartbreak” related depression.

Additional limitations include estimates made for the scale of change and the relative or comparative weights of the primary and secondary dopamine cycles, or between comparisons of these cycles, created by subjective data and analysis.

Census, sociology, Big Data, and criminal justice groups would be urged to regress this model with their vast year-over-year and larger data sets to find additional granularity and possibly additional contributing factors. Scientists, researchers, and medical professionals can work to confirm the number of dopamine cycles in the human brain via Big Data supercomputing top-down analysis as well as via f-MRI or PET brain scans and laboratory blood and sleep testing to qualitatively validate the theorized 40-day-long secondary dopamine cycle. The days or weeks in the model, when there are dual reinforcing peaks or troughs from both of the dopamine cycles, should be compared against data sets of violent crimes, mass shootings, stock purchasing, heart attacks, consumer spending, consumer sentiment, suicides, engagements, etc.

Results

An analysis of the subjective data indicated a second dopamine "clock" or cycle in the human brain. This cycle was measured starting with a 10-day-long "low dopamine" phase (with various stages of impulsivity, anxiety, and depression and then the reverse as dopamine levels climbed back up), then a 10-day-long "high dopamine" phase (with hyperactive and manic behaviors), before diminishing to a 20-day-long "normal dopamine" phase (with calm and focus), before the cycle starts again with the "low dopamine" phase (Figure 2).

A benefit of knowing, a priori, the likelihood of one's temperament on a given day or week, is that one could adjust or "sanity check" their decisions accordingly e.g., pause, seek advice, sedate, isolate, avoid spending, give the major speech, do the job interview, relax, or enjoy nature or the company of friends, etc.

Additional analysis of the temperament map shows that it is also consistent with research related to the timing of violence and aggression. Research "suggests that dysfunctional interactions between serotonin and dopamine systems in the prefrontal cortex may be an important mechanism underlying the link between impulsive aggression and its comorbid disorders. Specifically, serotonin hypofunction may represent a biochemical trait that predisposes individuals to impulsive aggression, with dopamine hyperfunction contributing in an additive fashion to the serotonergic deficit" (Seo et. al., 2008, pg. 1). Research by Seo, D., Patrick, C. J., & Kennealy, P. J. (2008) noted that:

> considering the functional regulation of serotonin over the dopamine system, deficient serotonergic function may result in hyperactivity of the dopamine system, promoting impulsive behavior. This relationship may account for co-occurring serotonin and dopamine dysfunctions in individuals with impulsive aggression (pg. 5).

Discussion

The creation and verification of an actual cyclical temperament calendar has the possibility to be formalized into an actual mood or impulsivity gauge. Obviously, the amplitude of any given map would be more severe for bipolar individuals due to their blue light sensitivity. One can envision a smartphone application or "dashboard," akin to a pilot's altimeter or cockpit instrumentation (Figure 5), showing a daily or weekly "score" or meter (Figure 6) as a form of "temperamentometer." Some additional possible applications could include an add-on feature for a Microsoft Outlook Calendar or an add-on feature for a Zoom or Microsoft Teams video conferencing meetings where the week of the year and participant location data (obtained via area code, I.P. address, or Active Directory information) could allow a salesperson to know which person in their meeting is most likely to make an impulsive purchase (individual with a red colored outline) versus "normal" participants (green) and those that are least likely spend due to anxiety, depression, or low energy (blue). The calendar feature can also be used to note when it is best for an employee (green) to give a speech or an important sales pitch and also which weeks to avoid (blue and possibly red).

A full list of potential uses of a temperament map could include using it to find: when to schedule a sales promotion and who (based on zip code or location) to most likely sell to, gym exercise workout routines - when to lift heavy (red) and when to light weights (blue), diet routines - when to fast diet (red) and when not (blue), optimal weeks for: military actions, holidays, long work activities or projects, medication adjustments (mental health), and when law enforcement should be aware of potentially increased violence.

Note, that while the scientific community can monitor gravitational waves smaller than an atomic nucleus, we have comparatively little tooling or visibility for "real-time monitoring" of dopamine and serotonin levels in humans and, thus, temperament, for a given individual. Progress is being made however, with current smartwatch technology now able to check metrics like blood pressure, pulse, and even blood sugar.

This proposal, while very speculative in nature and informal in presentation, is an effort to instigate additional focus in the direction of individual biochemical monitoring and feedback.

The claim of the work is that there are only three major factors (annual calendar neurotransmitter cycles – the primary sunlight and proposed secondary dopamine cycles and, for some individuals or population subsets, the fall and spring histamine/serotonin spikes) that play into an individual's temperament or impulsivity and that this temperament can be measured, scored, and predicted and, thus, help a person to avoid sub-optimal impulsive actions and poor decision-making. While advertising and marketing firms analyze Big Data related to aggregate consumer spending and sentiment data, this work proposes also examining behaviors and temperament from a biological basis.

A perfect long-term vision could involve nano-tech sensors inside individuals directly providing real-time feedback of dopamine, serotonin, and histamine levels, and also their external blue light and pollen levels, to help create an improved measure or score of an individual's temperament on a given day. Big Tech firms like Facebook (Meta), Twitter, or Google (Alphabet) could even use their massive behavioral data stores and super-computing resources to examine human temperament or mood from texts and social media post "text analysis" to produce an optimal temperament assessment tool. This tool would allow an individual or party to know the likelihood of their own bias toward (or against) impulsive, emotional, or irrational action to allow proper assessment of factors (including their own "state of mind") for better decision-making. Consider the scenario where, if you knew that you would be anxious on a given day, you could proactively move the date of your major speech. If you know you are at risk of impulsivity today, avoid the trip to the shopping mall or, from the vendor perspective, increase the number of advertisement buys.

Conclusion

While modern civilization in the 21st Century is still far from the societal behavioral prediction capabilities of a science like *psychohistory* envisioned by Isaac Asimov in his Foundation science fiction novels, the possibility should not be considered out of reach. Changes in the level of dopamine can both lead to impulsive, depressed, and hyperactive behavior. Thus, the two main points of this work involve a proposed additional 40-day-long dopamine brain clocking cycle and that an examination of this cycle aggregated with the annual sunlight dopamine cycle can lead to a *human temperament map* or calendar to predict individual and even aggregate societal behaviors.

Figures

Figure 1

The primary sunlight-driven (blue light level) dopamine cycle with shorter wavelengths in winter and longer in summer where temperament varies between Hyperactive – Impulsive, Normal – Calm – Rational, and Anxious – Depressed mental states and behaviors.

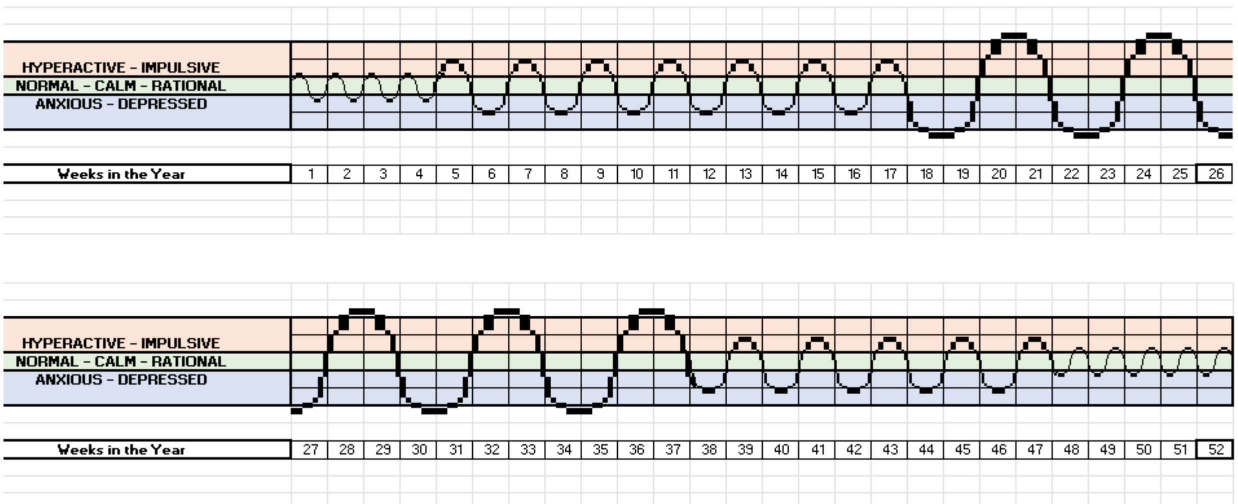


Figure 2

The proposed second dopamine clock-cycle involves a wavelength of 40 days that includes the first 10 days in an interval where there is a "low dopamine" state. The nine dates below are the lowest dopamine level dates of each of the nine cycles.

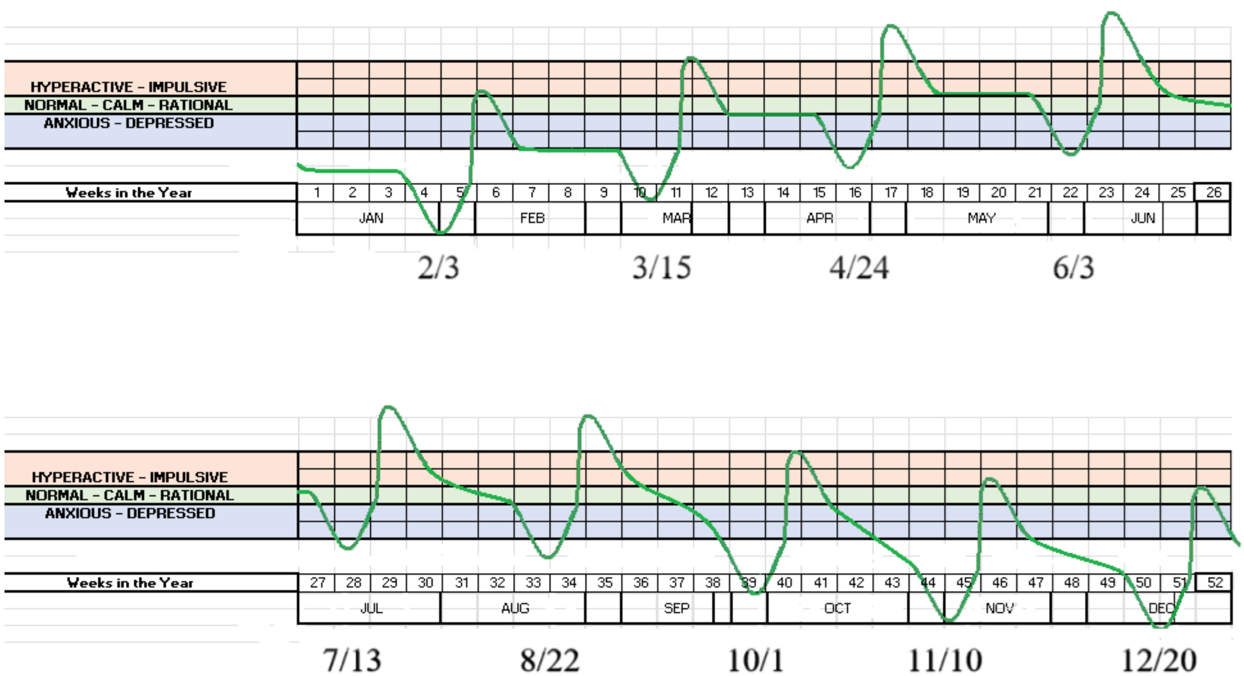


Figure 3

A combined graph of the primary dopamine sinusoidal annual wave with the additional proposed secondary 40-day-long cycle is shown below that is used to create a final aggregate graph or "temperament map."

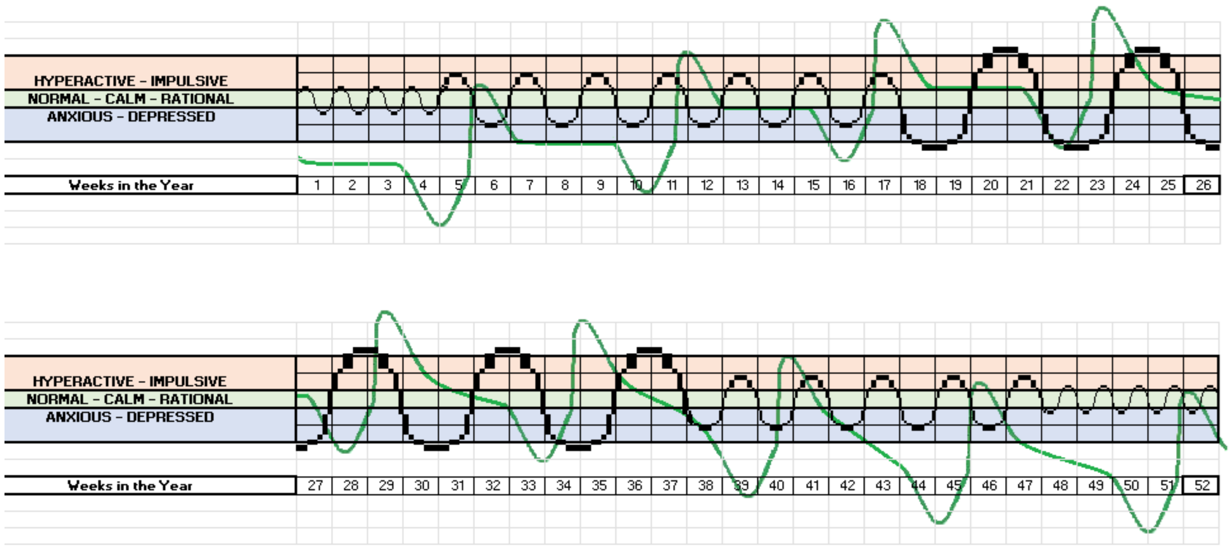


Figure 4

An aggregate summation graph from the combined values of the two dopamine cycles produces this "human temperament map," the red line in the image below.

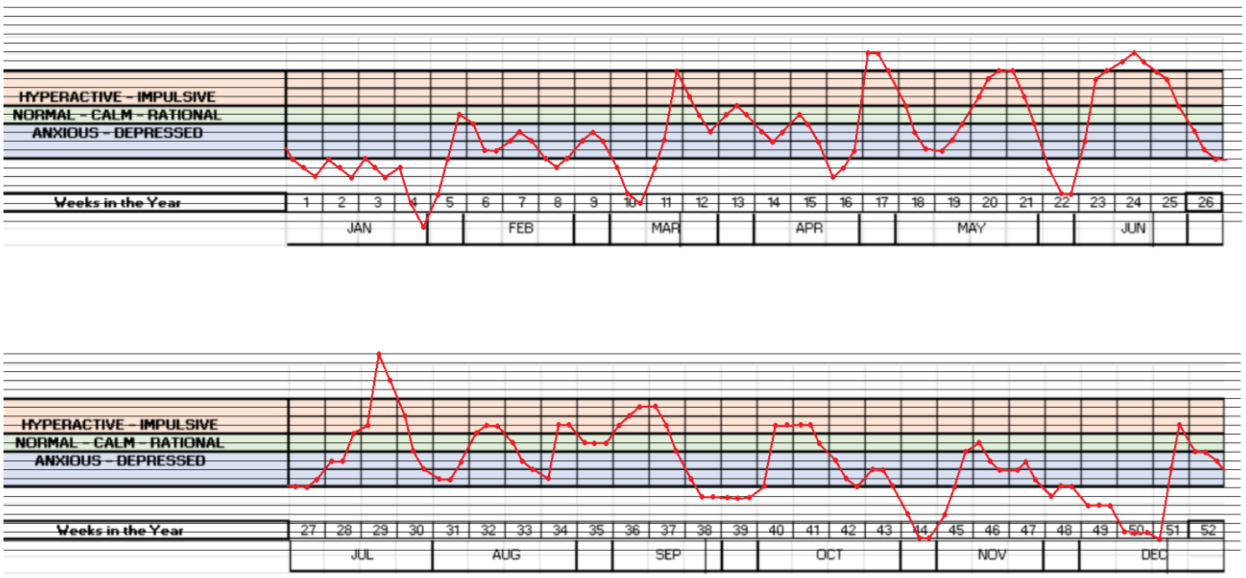


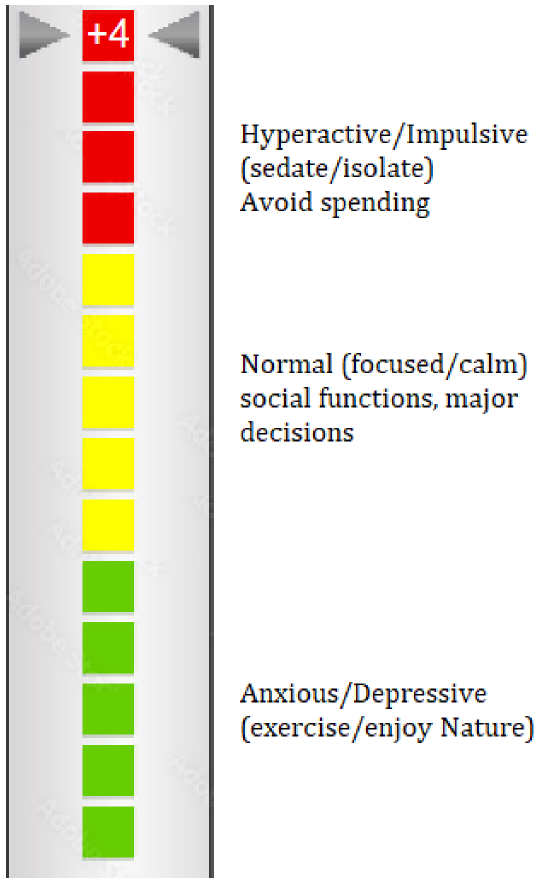
Figure 5

An aircraft cockpit instrument that monitors real-time altitude and orientation as an example of a "state" monitoring tool. An application that is presently absent for human neurotransmitter levels and temperament.

Source: https://allavionics.com/product/uavionix-av-30-c-primary-flight-display-certified/?gclid=Cj0KCQiAgP6PBhDmARIsAPWMq6mYOXR2xaEPKh_fBgayUXjlJJD1DIXeyipNQ7nudgaN38LTI1gdBOsaAkmwEALw_wcB

Figure 6

An example of a possible smartphone application where a standard scale is used to notify the user by color and the number of their measure of temperament per any given week or day of the year to allow them to adjust accordingly knowing how neurotransmitters are impacting their state of mind.



Source: https://www.123rf.com/photo_140341271_stock-vector-bar-of-meter-with-progress-level-from-red-to-green-vector-illustration.html

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