SPRING FEVER:
LOVE IS IN THE AIR – OR NOT?

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Insight

"If we had no winter, the spring would not be so pleasant" (Anne Bradstreet). After a long winter, people appreciate the first sun rays in spring. Flowers are blooming, the temperature increases, people seem to be happier, and "Love is in the air". Poets have called this phenomenon 'spring fever'. But is that actually a thing? Are people happier, and do they show increased amorousness? And if so, why is that the case?

The definition of spring fever

When the days start to become longer and the temperature increases, many people are more restless, energetic, and romantic. This phenomenon is called spring fever and it is, as the name implies, associated with the onset of spring [1]. Since these episodes of good mood are associated with a season, it seems evident that they are bound to seasonal patterns, but is that really true? Is the mood seasonally changing? Spring is accompanied by more sunlight, warmer temperatures, and blooming plants all over, compared to the winter months that precede it; everything appears friendlier. It seems logical that the changes in the landscape can enlighten someone's mood. However, is there merit to believe that there might also be an underlying biological process that influences the mood and could lead to this so-called spring fever?

Circadian rhythm

The most significant seasonal change is the amount of daylight someone experiences. In spring, people usually experience higher exposure to sunlight on average due to increased amount of daylight. What does this have to do with the seasonality of mood? Humans, as well as other organisms, need to adapt to these environmental cues, which are key regulators of organisms' biological processes, including quality of sleep or hormone production [2]. The circadian rhythm is the response to environmental changes involving sunrise and sunset [3]. By gene expression, the underlying circadian system can regulate the activity of brain regions involved in mood control and, therefore, indirectly affect one's temper [2]. Amongst other things, the circadian rhythm manages the production of melatonin, the so-called "darkness hormone", which suppresses neuronal activity during the night [4]. Altered melatonin secretion has been shown to be associated with changes in mood in major depressive disorder or seasonal affective disorder (SAD) [5]. Seasonal variations can affect melatonin production in the sense of longer days delaying the onset of its production in the evening [4]. Overall, longer days and, therefore, higher exposure to daylight positively affects one's circadian rhythm and the resulting inhibition of melatonin production. This results in increased mood and (neuronal) activity compared to shorter days: the spring fever.

Sunlight and Vitamin D

The increased sunlight in spring and summer affects not only the circadian rhythm but also the production of Vitamin D. The penetration of sunlight, containing Ultraviolet B (UVB) radiation, activates the Vitamin D production in the human body. It has been shown that depression, which is partly characterised by episodes of a bad mood, is linked to the level of Vitamin D [6]. Although there is no global cut off for Vitamin D levels, an insufficiency or deficiency is expected to provide a risk for the development of depression [7]. An optimal range in blood is assumed to be between 30-60 ng/ml, while insufficiency is defined at a level of 21-29 ng/ml and deficiency below a level of 20 ng/ml [7]. Knowing the link between low Vitamin D levels and depression leads to the assumption that sufficient Vitamin D levels, on the contrary, lightens up one's mood, meaning there could be an indirect link between sunlight and happiness [7, 8]. Apart from the effect on Vitamin D production, serotonin production is also affected by sunlight. Serotonin belongs to the class of neurotransmitters and functions as a neuromodulator. Imbalances in the serotonin levels have been associated with depression and compulsive disorders [9]. Lambert *et al.* showed that the serotonin turnover in the brain is the lowest in winter compared to the other seasons; however, there is also daily fluctuation based on the changes in luminosity [10]. This means that the longer the day and the higher the light intensity, the greater the serotonin turnover. Due to the natural upregulation that usually comes along with spring patterns, serotonin levels could be one of the factors, next to Vitamin D production, that leads to increased energy and enlightened mood during spring - the spring fever [8].

Summer – in favour

As discussed above, the increased exposure to sunlight in spring can have positive effects on one's serotonin and Vitamin D levels and, thus, indirectly on the mood and energy level. However, what does this intend for the darkest season in the year, winter? Murray *et al.* showed that mood was significantly lowered in winter compared to preceding summer in a study conducted over three years [9]. It is necessary to mention here that "positivity bias" exists in reports regarding happiness and well-being. People tend to judge experiences or feelings more favourably than they actually are, meaning in this study, the summer might be a generally positive baseline [11, 12]. Therefore, the investigated winter might

be experienced worse than it actually is, compared to the previous summer, but not below subjective norms [11].

Winter blues

Although there might be a positivity bias, there are people who experience a severely lowered mood in winter, having episodes of depression. This phenomenon is called SAD, also known as winter blues [13, 14]. SAD is considered a subtype of affective disorders that is accompanied by seasonal major depression and bipolar disorders, whereby the onset is often associated with the winter months. In the cooler months, these patients experience hypersomnia, increased appetite, and depressed mood, while spring and summer can be characterised by elevated mood, social activity, and energy as well as increased libido - patients experience full remission [9, 13, 14]. SAD is usually treated with phototherapy to provide artificial sunlight during the winter months mimicking the positive effects of sunlight on biological processes such as the aforementioned circadian rhythm, Vitamin D production and serotonin levels [9].

Spring fever: just the absence of winter blues?

Both winter blues and spring fever appear to be connected to sunlight and, thus, the seasons seem to affect one's mood by altering biological processes. However, not all people experience spring fever or winter blues. Actually, only a small part of the population is affected by severe mood shifts due to the seasons. People that are affected are usually known to be highly neurotic, which makes them more vulnerable to environmental factors [15]. This leads to the conclusion that there are, in fact, seasonal biological patterns that can be described in a poetic way as spring fever. However, the effect of spring fever is very different per individual and mainly associated with the mood during the winter season; as Anne Bradstreet said: "If we had no winter, the spring would not be so pleasant". If people suffer from winter blues or SAD, they experience a bigger mood shift due to biological changes caused by the environment. People who do not mind the winter season do not feel a strong shift in mood due to the start of the spring. Therefore, for some people, it seems that spring fever is just the absence of the winter blues or the other way around. However, it needs to be stressed that humans and their mood are affected by many factors such as the seasons, some more and some less. So, keep in mind, if somebody is having a 'rainy' day, try to 'lighten' them up. And do not forget the sunscreen over prioritising your mental health.

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