



Paper

The dopamine dividend: in the mood for employee happiness?

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Mood tracking – how are you feeling now? And now?

Psychological wellbeing at work is increasingly being seen as a factor of production or even as a source of competitive advantage in knowledge-based organisations. Employers want engaged, motivated, creative, innovative, cognitively flexible, resilient, committed and fulfilled workers. Yet it is now much clearer that, despite all of these benefits, poor mental health in the workforce can represent a costly disruption to productive capacity and a risk to business sustainability and stability. Doing more to protect the mental health of employees is not just a human and responsible thing to do but also an act of enlightened self-interest (Bevan and Cooper, 2022).

The way that both the theory and practice of managing people at work have evolved in recent years illustrates how some of the complex interactions between mental wellbeing, motivation, engagement and neuroscience have started to become a recognisable part of the managerial ‘toolkit’. This has given rise to a small but growing ‘happiness’ industry in which providers are jostling for position in the race to monitor the mood of the workforce. It is no longer enough to carry out an employee survey every two years to check on staff morale. It is much more common to have a smartphone app or even a wearable device to capture in real time the daily fluctuations in our feelings, emotions and moods.

Some argue that, with mood tracking apps and wearable devices to capture how we are feeling 24/7, we now have an impressive choice of technologies at our disposal which can help employers and employees monitor, analyse and manage our emotions and mood at work. Each of us can now access personalised support to ensure that we need never be unhappy or disengaged at work again. Others argue that the commodification of our motivations, pleasure hormones and impulses is just one step away from a dystopian vision of work in which surveillance, monitoring and manipulation of our mood become as familiar a business metric as headcount, sickness absence or hours worked.

In this paper we will look at why emotion and mood at work has become such a commodity. We will ask about the science behind the explosion of mood tracking apps and the practical and ethical choices we need to make before we embrace this technology as a mainstream tool for worker wellbeing, engagement and productivity enhancement.

What makes us happy?

Doesn't everyone want to be happy? That, at least, should be a goal that unites us all – despite any differences we might have. There are many definitions. One which seems to be uncontroversial comes from Sheldon and Lyubomirsky (2007) who argued that happiness is:

‘...the experience of joy, contentment, or positive wellbeing, combined with a sense that one's life is good, meaningful and worthwhile.’

However, in some respects, that is where the unity stops. Once we get under the bonnet of happiness as part of the human condition, it quickly becomes clear that each of us is

looking for slightly (or sometimes radically) different sources of happiness. Relationships, money, security, adventure, property, recognition and solitude can all make some of us happy to different degrees for at least some of the time. For the most part, this diversity is enriching and makes life very interesting. If we were all made happy to the same extent and by the same things, then the worlds of retail, entertainment, culture, travel, online dating and work would be very dull indeed. If we focus just on happiness at work for a moment, we now accept that different aspects of doing a job and working for an organisation deliver happiness, contentment, joy and fulfilment in different ways to different people. Yet, not that long ago, such a view was seen as over-indulgent and unnecessarily complicated for some who were ‘thought-leaders’ on work, motivation and productivity.

For example, at its most basic, the philosophy underlying Frederick Taylor’s ‘Scientific Management’ approach largely bypassed the idea that there could be meaningful individual differences in motivators between employees. Taylor advocated breaking jobs down into small components, attaching payments to the performance of each task and relying on the motivational power of the need by the average worker to earn money to deliver outputs and to drive up productivity. Expectancy theory at its most basic (Vroom, 1964). For a while, and within certain work settings, this approach delivered results and had the advantage of protecting foremen, supervisors and managers from the need to indulge the individual preferences of the workforce.

The essence of Taylor’s approach remained popular among many business leaders because, in the short term at least, it delivered results and it attracted some superstar adherents. Henry Ford, for example, was both an innovator in automotive manufacturing and a strong believer in a notably ‘instrumental’ model of human motivation. Ford famously rejected the idea that happiness, joy or contentment had a significant part to play in the workplace:

‘When we are at work we ought to be at work. When we are at play we ought to be at play. There is no use trying to mix the two.’

So, in some ways, the practice of psychology at work began with widespread belief in the principles that:

- Even if workers were motivated by different things, narrowly constraining their work and linking all of their activity to the pursuit of cash essentially removed the need to pay any attention to whether or not they were happy. Obedience, hard work and compliance were all they needed to display.
- Fulfilment, meaning, contentment, joy and happiness were needs which should be preoccupations outside of the workplace.

It’s hard to imagine that the modern mantra of ‘bring your whole self to work’ would have cut any ice with Henry Ford. Indeed, his own happiness at work seemed to be very much linked to whether his workers were choosing to spend their wages on one of his cars. Today’s landscape is very different because, rather than doing everything possible to downplay the role of human happiness at work, most modern workplaces are characterised by practices which try to harness the need we all have in our jobs to achieve something meaningful, to connect with others, to find our work intrinsically

rewarding and to contribute through our efforts to some wider, animating purpose. While it is easy to over-romanticise these needs and instincts, and it is certainly true that our drive to achieve these things (or the opportunities to do so) varies widely, it is not controversial any more for bosses to be concerned about the subjective wellbeing and satisfaction of their employees. Happiness at work has gone mainstream.

One of the reasons for this is that organisations realise that our so called 'affective states' are strongly linked to behaviours which employers want to encourage. These include choosing to join an organisation in the first place, attending work regularly, performing well in our jobs and choosing to stay rather than quit. Many employees recognise that morale, motivation, engagement and mood can be quite good predictors of these behaviours so monitoring even subtle changes in mood can give them an edge in understanding and predicting some business-critical behaviours. So, let's explore the concept of moods in a little more detail. Moods are defined as:

'...affective states that may last from several hours to several days and are strongly influenced by external events and by factors such as stress, social activity and exercise as well as by endogenous cycles or rhythms.'

(Ortiz and Grof, 2016).

It is the sometimes short-term or transitory nature of some moods which differentiate them from more permanent or stable traits such as optimism or pessimism. Organisational psychology and human resource management have taught us that enriching jobs and making them rewarding can contribute to job satisfaction. In the 21st century workplace it is now felt to be important to embrace the neuroscience of happiness, motivation and mood to truly understand what might trigger an employee's reaction to their working conditions, their boss or their workload.

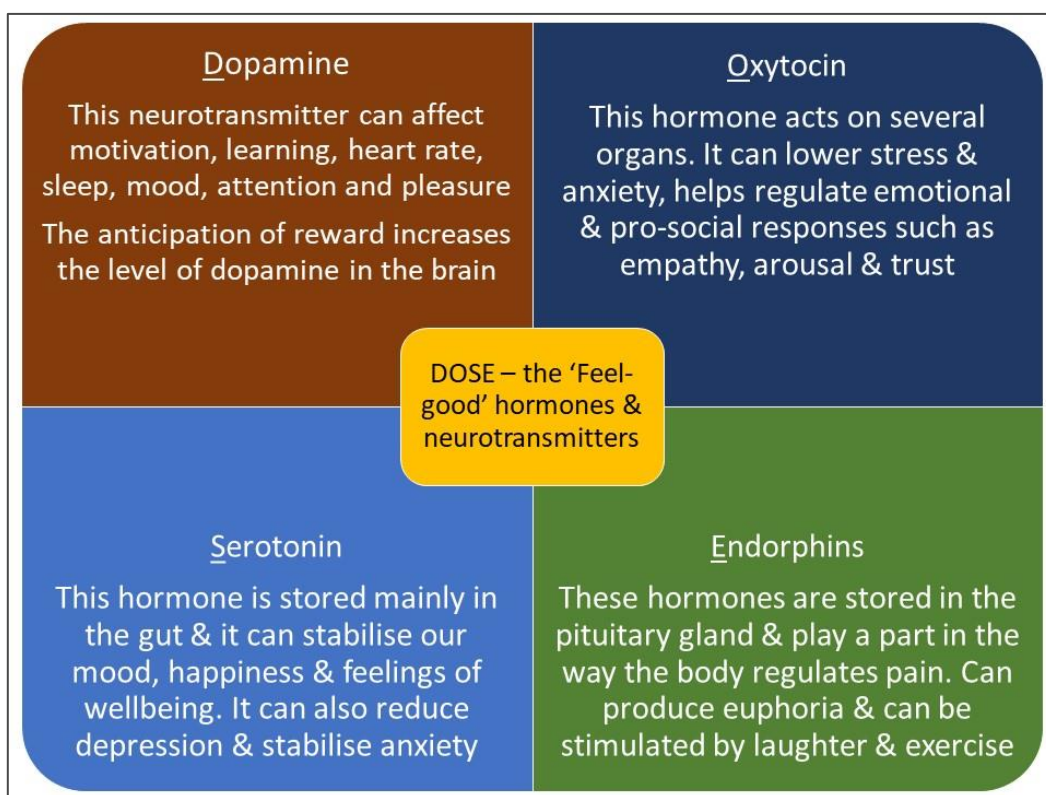
Our definition of 'mood' emphasises that our emotions and affective states can swing quickly and are influenced by many factors. This volatility informs the rationale for keeping a close and regular eye on the mood of employees so that variations can be anticipated. This is partly why 'pulse' surveys have become so much more frequent in recent years. Mood tracking is becoming an equally attractive idea for some employers because it offers the chance for employees to monitor fluctuations in their own emotional wellbeing and to play a more active part in the regulation of their own moods.

This all raises at least two philosophical points about our journey from Taylorism to neuroscience as a foundation of management practice. First, the emphasis on self-monitoring and self-management is not so far removed from the idea of self-cure. Although most mood tracking apps offer signposting to third-party support for those with high levels of anxiety or distress, it can be hard to escape the implication that it is largely down to the individual to manage their own mental health. This is a criticism sometimes levelled at interventions aimed at improving 'resilience' at work - that they focus more on boosting an individual's resources and coping strategies without paying as much attention to the work demands or organisational culture which may have contributed to the problem.

Second, this interest in neuroscience signals the crossing of a new frontier in human resource management: the appropriation of so-called ‘feel good’ hormones and neurotransmitters in the pursuit of enhanced employee engagement, wellbeing and productivity (Davies, 2015; Zak, 2018). Specifically, the research in this field has focused on the four so-called DOSE brain chemicals and the ways that each influence our mood motivation arousal and drives (Breuning, 2025; da Silva et al., 2018; Mani and Mishra, 2021).

Figure 1 sets out the roles that dopamine, oxytocin, serotonin and endorphins play in stimulating happiness and motivation.

Figure 1 ‘DOSE’ brain chemicals linked to happiness and motivation



Source: Institute for Employment Studies, 2021

The scrutiny of moods through self-monitoring apps, through facial and voice recognition software or even with brain wave or muscle tension measurement, illustrates that a growing number of tech developers and employers believe there is a ‘dopamine dividend’ to be gained from investments in these tools. Let’s take a closer look at these technologies and the evidence base which might give us confidence that their use amongst employees is warranted and beneficial.

Technology and mood tracking

Mood tracking or monitoring has a long history, especially in clinical settings. As Ortiz and Grof (2016) explain, the modern emphasis on self-reported mood has echoes in early 20th century psychiatry which placed considerable emphasis on the fluctuations in moods described by patients with, example, bipolar disorder.

Although - later in the century - clinical practice became more reliant on what were seen as less subjective diagnostic criteria and observations made by psychiatrists themselves, there has been a more recent resurgence in the use of self-reports and a recognition of the authenticity and importance of the lived experience and the patient voice. Today we have both a widespread recognition that mental health at work is an important topic (especially given the challenges of the pandemic) and the proliferation of personalised, portable and wearable technology which allows data on mood and emotional wellbeing to be collected, stored and analysed.

Perhaps the dominant technology currently in use is the smartphone app. There are thousands available which allow users to monitor their exercise levels, nutrition, alcohol intake, blood sugar levels, sleep quality and even whether their headphone volume is within safe limits. The growth of mental health and mood tracking apps has been noteworthy, and these are now more commonly used by employers as part of sophisticated employee benefits packages aimed at promoting health and wellbeing. In most cases, mood tracking apps require users to record their mood or emotional state at least once a day using simple visual ratings (often 'smiley' faces, Branco et al., 2020). These data can be accompanied by other metrics, where the user is prompted to report how well they slept the night before, whether they have taken any exercise, how well-hydrated they are and so on. This can allow the user to see whether their prevailing moods are associated with other aspects of their lives (for example, if their moods are lower after poor sleep). Occasionally, an app may prompt a user with several consecutive days of low mood to consult some additional resources. Others only provide 'rewards' if the user makes several consecutive entries, regardless of the mood recorded. Almost all of these apps have, in their terms and conditions, disclaimers to remind users that they use the app at their own risk and that they should consult a professional rather than rely on the app for clinical guidance. Despite this caution, mood tracking and mental health apps in the modern era should, in theory, have a number of benefits (Mahli et al., 2017):

- They are inexpensive (although many require payment for additional features).
- They can reach large numbers of people.
- They have the potential to reach and support stigmatised or hidden groups who may be reluctant to seek help them in a way that is revealing of their identity.
- They offer 24/7 accessibility.
- Their content can be updated regularly with the latest data or advice.
- They are more likely to be acceptable to younger people for whom apps are a normal way of consuming and interacting with online content (Matthews et al., 2008).

- Most enable simple and accessible visualisation of patterns and trends in an individual's data.
- They can provide access or signposting to supplementary and targeted support material, short videos and educational material for people with issues with sleep problems, eating disorders, anxiety etc.
- They allow almost instant feedback and support.

Several studies have looked more systematically at the content and functionality of these apps. Nouri et al. (2018) conducted a review of 23 papers and found a large number (38) of ways of assessing the effectiveness of mental health apps with an unhelpful vagueness and overlap in the ways these assessment criteria were applied. This lack of any systematic framework for evaluation led the authors to conclude that the apps under review were too heterogeneous to allow firm conclusions to be drawn. Caldiera et al. (2018) carried out a 'feature analysis' of 32 of the most popular mood tracking apps. The authors used a 'personal informatics systems' framework to categorise the ways the apps worked. The results indicated that most of the apps focused significantly more on the 'preparation' and 'data collection' stages of the model and much less on the 'reflection' and 'action' stages, during which users are guided on how they can make sense of their data and use it to adjust aspects of their lifestyle.

Larsen et al. (2019) conducted a similarly systematic assessment of 73 mental health apps. Of these, 64 per cent claimed to be effective at diagnosing mental health problems, improving symptoms and supporting the self-management of mood. However, only 1 of the 73 included a citation to a robust published study citing supporting evidence. In addition, only 14 per cent had explicitly included people with lived experience of mental illness in their design. One study (Peters et al., 2018) which did include user experience as a major part of its design found that, in male-dominated workplaces, stigma about mental illness was high and that smartphone apps which used terms such as 'mental illness' were viewed with suspicion as they were felt to reinforce stigma and act as a barrier to use. Clearly, for many groups, language matters.

Research by Dunkl and Jimenez (2017) interviewed 438 business leaders about the likelihood of using mood tracking apps with their employees. Younger leaders in the sample were more positively disposed to the use of such apps, although the majority were unhappy about over-reliance on an algorithm to generate feedback and guidance to users, with most preferring that users had face-to-face or remote access to an expert in clinical psychology or related discipline to offer tailored advice.

Rowland et al. (2020) reviewed the literature on the clinical effectiveness of mental health apps. They, too, noted the lack of well-designed evaluation studies, the lack of user involvement in their design and the potential for selectivity and bias in the way results are reported. They highlighted that, even in the cases where apps received positive reviews from users, almost none were able to demonstrate a sustained impact beyond a few weeks (findings echoed by other studies – eg Alavian Ghavanini et al., 2018). The authors conclude that:

'there are only a small number of clinical scenarios where published evidence suggests that mHealth apps may improve patient outcomes'.

Some reviews have found more positive results. Linardon et al. (2018) carried out a meta-analysis of 66 studies of app-based smartphone interventions aimed at supporting mental health. Apps had a more positive impact on depression and anxiety symptoms than conventional interventions, but had no measurable impact on panic symptoms, post-traumatic stress or low mood. Apps using a cognitive behavioural therapy element also performed better.

Another area which receives some tentative support is in the guided use of mindfulness techniques facilitated by wearable devices capable of picking up respiratory patterns and presenting them visually via a smartphone app. A small trial (169 people) conducted by Smith et al. (2019) found that, after four weeks, subjects in the intervention group reported 28 per cent fewer days of feeling anxious or stressed than those in the control groups. However, no other aspects of subjective wellbeing were positively affected during this trial.

Although there is an understandable focus on smartphone apps, it is worth recognising that there is a growing array of technologies which can detect variations in moods and emotions, each of which have current or potential workplace uses.

The British Airways 'happiness' blanket

In business sectors where a company's ability to make you happy, contented and comfortable gives them a competitive edge, technology is being trialled which brings science to the art of customer service. British Airways, for example, has been experimenting with a 'happiness blanket' which can signal a customer's mood to cabin crew, even when they are asleep.

It works in conjunction with a headband, which measures your brain wave activity, then wirelessly conveys it to the blanket, which is embedded with red and blue LED lights. The blanket uses neuro-sensors to measure the electrical fluctuations in the neurons of passengers' brains, and changes colour depending on their state of mind. They flash red when they are miserable or blue when they are in a 'Zen-like state of mind'.

As a BA spokesperson explained, 'What we found was that the blankets turned bluer when people were relaxing, such as sleeping, listening to relaxing music, or eating, as that created a feeling of wellbeing. However, eating cheese for example can often turn the blankets red, as that releases a chemical in the brain which increases brain activity.'

It may not need such a leap in imagination to think of work-related scenarios where brain wave activity could be captured to identify different mood states of employees in safety-critical jobs, or where the non-verbal monitoring of emotional wellbeing might provide an early warning of a risk of a dip in performance or an expensive error.

Of course, the days when answering a simple question from a boss or colleague to report on your mood in a face-to-face conversation or in a questionnaire seem to be ending. With so many of us now using video calls to connect with colleagues or clients these days, the rise of facial recognition software which can identify your emotional state is almost complete. And there is no shortage of such applications to choose from.

Facial recognition of emotions – Imotion and Rekognition

Imotion software, for example, detects what it calls *'the nonconscious muscle movements of the face that occur in response to subliminal exposure of emotional facial expressions.'*

By using facial electromyography (to detect changes in muscle activity that may not be visually detectable), their analysis has shown how *'psychophysiological responses occur in even in the absence of conscious awareness, suggested to be the result of nonconscious cognitive processes.'*

The company explains that it provides *'non-intrusive methods with which to assess human cognitive and emotional states during or after training and performance scenarios like simulations, virtual reality, occupational safety exercises, remote work and telecommunications, or task execution. Combining these biosensor modalities provides an even more nuanced and detailed understanding of the underlying behavioral, cognitive, and attentive processes connected to an individual and his or her performance than pure observation, questionnaires, single sensors, or reviews can achieve.'* So, who knew that so much about our mood could be detected digitally from just a frown, a grin or a yawn?

Amazon has its own company offering business customers a facial recognition application which identifies at least eight emotional states. Rekognition has been assessing emotions in faces along a sliding scale for several categories: happy, sad, angry, surprised, disgusted, calm, confused and fearful. Amazon does caution customers about relying too heavily on readings of emotions using its tool. It says that *'a prediction of an emotional expression is based on the physical appearance of a person's face in an image. It doesn't indicate a person's actual internal emotional state, and you shouldn't use Amazon Rekognition to make such a determination. For example, a person pretending to have a happy face in a picture might look happy but might not be experiencing happiness'*. Despite this disclaimer, it is not hard to imagine a number of commercial and workplace applications in which such capabilities would be very tempting to exploit.

It is not just facial expressions which can reveal our emotional states. For some time, it has been known that aspects of the way we speak, especially in certain circumstances, can give an indication of our mood and can be detected by software applications.

Detecting stress from voice measurement

In a number of studies reviewed by van Puyvelde et al. (2018), the different components of the spoken word which reveal something of our affective state were examined. For example, 'jitter' - tension of the cricothyroid muscle or fluctuations in subglottal pressure - can result in subtle variations in the voice (phonation) or even hoarseness if a person has a high emotional load. High levels of physical exertion and 'perturbations' of breathing caused by emotional distress can also be detected via software. Emotional wellbeing is also thought to affect the muscles involved in the shaping of the resonant cavities of the vocal tract system, which are involved in sound shaping and vowel and consonant pronunciation. It is also thought that people seeking to conceal anxiety can exhibit over-accurate articulation of some words when under a high cognitive load, which may be indicative of an effort to speak in a more controlled manner.

Finally, even the most minute and barely detectable movements in parts of our bodies are sufficient to indicate our emotional states.

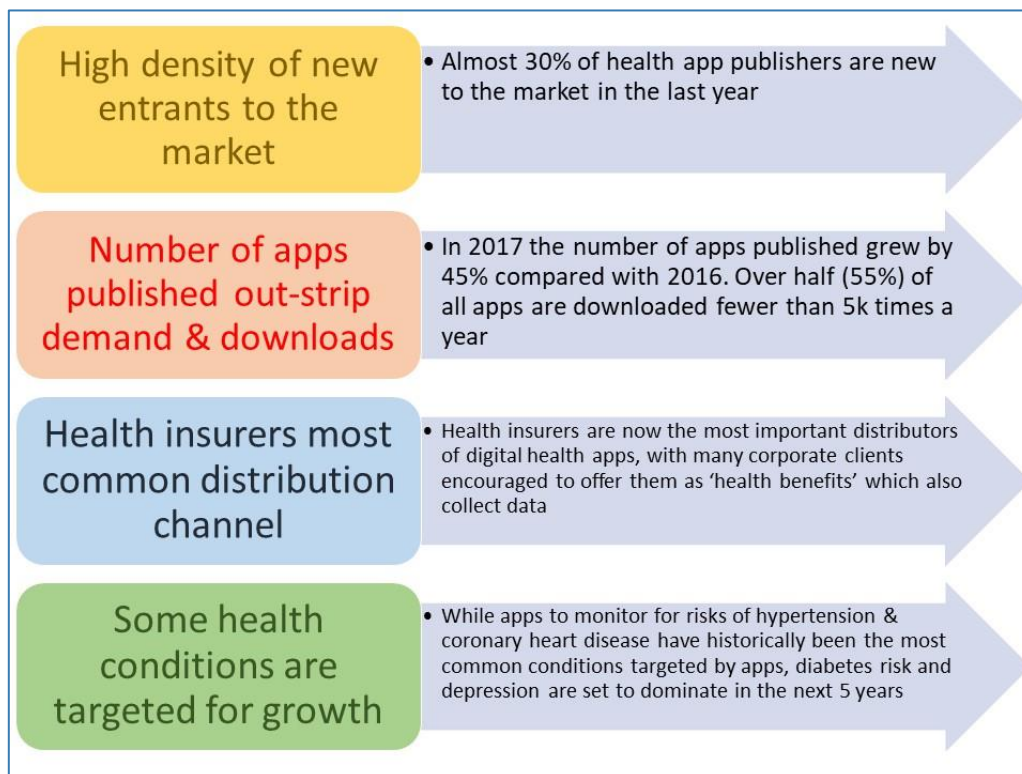
Detecting stress from muscle movements

One study (Kim et al., 2020) discovered that there is a relationship between the muscle tension in the arms of computer mouse users and their levels of stress. Researchers attached remote sensing devices to the upper arms and forearms of workers who routinely used a mouse and found that the way the mouse was gripped, moved and used was a predictor of anxiety and emotional distress.

Evidently, despite our efforts to conceal or disguise them, many of our moods and emotions are on display for much of the time and can be detected, recorded and analysed by an increasingly diverse range of devices and technologies. Some of these applications may have desirable uses. For example, detecting an elevated degree of distress in an air traffic controller or a build-up of stress in an ambulance call-handling employee. Other applications may have less obvious utility, despite their novelty and superficial attractiveness. So, what are the 'rules' governing the use of this technology and how should we make sure that they are used responsibly and transparently?

Mood tracking – unregulated 'bandit country' or responsible governance?

It seems that the mood tracking app and other digital technologies which monitor our emotions at work and beyond are gaining a momentum all of their own. Such has been the proliferation of these tools, it might even be argued that their growth is sometimes more 'provider-led' than a genuine response to a well-articulated demand from either employees or employers. Data collected on the whole health app market by business analysts Research 2 Guidance (2017), suggest that the explosion of health apps in the UK, European and US markets is not necessarily a reflection of a strong growth in demand. Figure 2, below, sets out some headlines from some recent market analysis.

Figure 2 Characteristics of the digital health app market

Source: *Research 2 Guidance, 2017*

One concern here is that individuals and employers wanting to invest in mood tracking products are faced with a sometimes bewildering choice. Without regulatory or even clinical oversight, of course, there is a significant risk that an eye-catching app, with innovative features, will appear a more attractive 'perk' than a more workaday app underpinned by more clinical evidence and producing better and safer outcomes.

We have to remember that, in most cases, any persistent low mood detected by an app or wearable device (or a blanket!) might be a 'red flag' for an elevated risk of clinical depression, an anxiety disorder or even something more serious. So, mood tracking is not a game, nor should it be entered into lightly without some clear-sightedness about what an individual or employer should do if such a 'red flag' presents itself. Some argue that a new framework of ethics, regulation or governance may be needed to ensure both the design and application of mood tracking tools are subject to high standards and appropriate oversight.

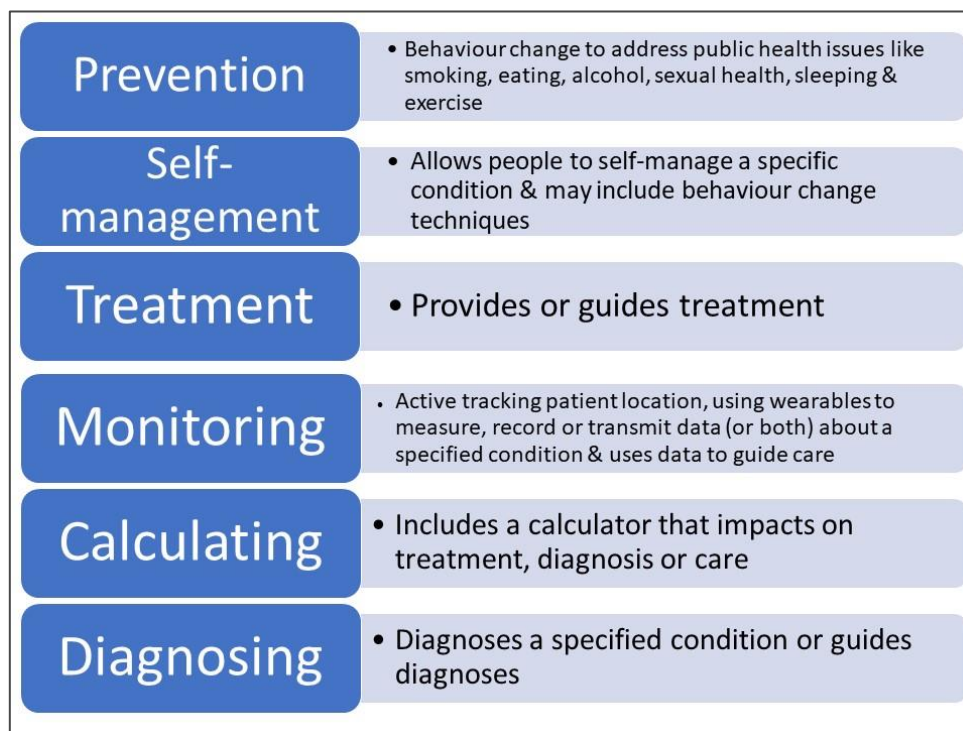
Although not developed specifically for mood tracking technology, the National Institute for Health and Care Excellence (NICE) has produced guidance about the design and use of a number of digital technologies. First, it recommends that five key areas of risk should be routinely assessed. To do this, NICE suggests using these contextual questions to identify any potential specific risks associated with a digital health technology, all of which seem perfectly applicable to mood tracking apps too:

- **Are the users in vulnerable groups?** Are these users always 'competent' to use, interpret and act upon the data generated by the technology in a safe way?

- **What are the consequences of technology failure?** Could a failure elevate either the risk of harm to an individual or increase their vulnerability?
- **Is there professional oversight?** Is a qualified person or body on hand to anticipate or manage the consequences of an adverse event such as an emotionally vulnerable person being ‘triggered’ by a feature of the technology?
- **Is artificial intelligence used?** Are algorithms capable of managing all adverse scenarios? Can they raise the alarm, alert a third party or provide ‘signposting’ to further resources if a non-routine problem occurs?
- **Is a very high cost expected?** Could an individual or employer become over-reliant or ‘locked-in’ to the use of a technology or even be drawn unwittingly into incurring unforeseen expense by using it?

Another important goal of oversight is to ensure that the purpose of any digital tool is clear to the user. In Figure 3, below, we have adapted the ‘functional classification’ model produced by NICE to help clarify the potential applications of these technologies.

Figure 3 NICE functional classification of digital medical interventions



Source: Institute for Employment Studies (IES) adapted from NICE

Clearly, for both user safety and to match the tool to the context in which it will be used, it is essential that an app is not used, for example, to diagnose a mental health problem if it is not designed or validated to do so.

Monitoring mood at work – where next?

If mood tracking and other technologies which can capture data on our affective states are here to stay, what does the future hold, what safeguards do we need to put in place and how happy should we be that our employers are taking such a close interest? In this final section, we will take a look at some of the issues which our search for a ‘dopamine dividend’ raises about the future of neuroscience as another branch of human resource management. We think there are at least four questions we need to ask if we are going to allow mood tracking to become a mainstream part of modern management practice.

- 1. Is mood tracking a ‘perk’ or an intervention?** Most responsible employers are genuinely interested in the mental wellbeing of their employees. They know that stress, anxiety and depression are being destigmatised and can affect staff absence, customer service and productivity if they are not managed well. Employers offering employees access to mood tracking and other health apps via their workplace health promotion packages (often through health insurance or benefits providers) do so in ways which allow individual employees to use them as they wish – as a voluntary method of keeping track of their mood, sleep or hydration, with simple, non-intrusive guidance and support for those who want to use it. Almost all of the apps have an abundance of disclaimers about the clinical validity of these tools and almost none purport to have any diagnostic or treatment role – correctly referring employees with concerns or symptoms to seek support from a medical professional. But the boundary between a weekly or monthly ‘pulse’ survey and hourly data collected via smartphone, a wearable device or a facial recognition tool embedded in a videoconferencing programme may be more porous than we currently think. Many of us would consider the crossing of this boundary to be a violation of a number of privacy, data security and ethical principles. For example, capturing mood data from smartphones or laptops to build an aggregated picture of the emotional state of a team or the whole workforce is technically possible now. Without a clear ethical or governance framework to provide oversight of the future development and use of these technologies, there remains a risk that mood tracking shifts from being a moderately benign activity to one with more than just sinister potential.
- 2. How do we ensure consent, supervision and governance works?** No matter how benign most of these technologies currently appear, those that develop and promote them will always have a number of questions to answer regarding ethics and governance. For example, how do the designers of the apps and the employers who promote them ensure that any potential adverse impact on vulnerable subjects is being mitigated? For example, an employee with a pre-existing but undisclosed anxiety disorder or an employee with a history of suicidal ideation may – in certain circumstances – be at an elevated risk of an episode of distress which may need clinical support. Very few, if any, of these apps make clear how these scenarios should be managed. Disclaimers in the small print of these apps may protect app developers and employers from legal liability if the mental health of an employee is harmed by using an ostensibly benign app. The moral liability may be less easy to evade. It may be that a more considered approach to gaining informed consent from users of these

apps or technologies might result in more cautious and responsible development and promotion efforts.

- 3. How does mood tracking account for individual differences?** Psychology tells us that, although some traits and behaviours are shared within specific sub-groups of the population, it is always important to recognise the role of individual differences. Doing so prevents us from making too many generalisations and from being too certain about predicting attitudes or behaviours. While mood tracking apps have an engaging face validity to them (rather like horoscopes) relying on them too much can be dangerous. To some extent, the concept of a 'mood' is not especially scientific and, some would argue, is not much more than a social construct. For example, in some cultures, being 'up', socially engaging, cheerful and outgoing are 'desirable' characteristics which are rewarded with approval, inclusion into some social groups or which are positively sought by employers recruiting into customer-facing roles (Cain, 2012). In some cases, introverts might judge themselves harshly if they do not feel as sociable or outgoing as others in their peer groups. Indeed, some clinical research suggests that the dopamine pathways of extroverts are more active than those of introverts. DeYoung et al., 2010, found that the medial orbitofrontal cortex – an important part of the brain's dopamine-driven reward system – is larger in extroverts than introverts. Personality type may not be the only individual difference which mood tracking may not be sensitive enough to accommodate. More employers are now aware, for example, of the need to be inclusive towards employees who identify as neurodiverse. They may live with a condition on the autistic spectrum, for example, and their experience of 'moods' as conceived by most mood tracking apps may be highly individual and may defy conventional categorisation. In these circumstances, any implication that some moods are 'normal' or are being recorded within 'normative' boundaries can not only be wrong, but also reinforce stigma and exclusion of significant groups of employees. Finally, and returning to the Ortis and Grof (2016) definition of moods, it is essential that we do not ignore what they call 'endogenous cycles or rhythms' as factors affecting moods. Examples here may include natural fluctuations and variations in moods experienced during pregnancy, during the menstrual cycle and during menopause (Soares, 2020). While not affecting everyone in the same way, an over-simplified approach to monitoring mood during such 'cycles or rhythms' can lead to results which are difficult for an expert to interpret, let alone an individual to make sense of. Unless mood tracking apps and other technologies are able to take adequate account of the individual differences set out here, it is unlikely that their wider application as diagnostic or treatment aids will have clinical credibility or practical reliability.
- 4. Do apps 'crowd out' the use of more evidence-based interventions?** If we are serious about promoting mental wellbeing at work, then the measures which employers need to take are well-established and articulated by a growing evidence base. They include taking steps to assess risk, putting in place preventative measures, providing employee support pathways (to an EAP, for example), ensuring job demands can be adjusted in line with the resources which employees have to cope with pressure and having a supportive line manager. Ideally, organisations who want to give their employees access to mood tracking apps will be doing so as a supplement to a range of less glamorous but evidence-based interventions. In such circumstances, any

escalation to further support or resources triggered by the app can be readily accessed. However, if apps are used by any organisation instead of doing the basics, then this represents a potentially harmful 'crowding out' of interventions to which most employees should have ready access.

We clearly need to add the insights of neuroscience to the range of disciplines and concepts which informs evidence-based HR practice. Decades of research on employee motivation, performance and other behaviours has added to our understanding of how to engage employees and align their behaviours to the goals of the organisations they work for. But just as ostensibly credible and 'scientific' concepts such as employee engagement and discretionary effort were embraced perhaps too uncritically by many HR professionals, some of the claims of neuroscience and its application to mainstream practice need to be properly scrutinised. Mood tracking apps are just the most prominent vehicle for the promotion of neuroscientific principles at work today. For employers hoping to cash in on a 'dopamine dividend' from embracing the use of mood tracking apps and technologies, much more work will be needed to ensure that an ethical governance and safeguarding infrastructure is put in place to ensure that employees are not exposed to preventable risks of harm.

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