



BIOFEEDBACK GAMING USING HAPTIC TECHNOLOGY

By Casingdom LABS

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Casingdom LABs plan to explore the application of wearable devices and haptic technology to introduce a distinctly human touch into the world of online gaming.

By understanding and measuring a person's stress response using a variety of biomarkers, and communicating any changes during high pressure gameplay via haptic technology - online poker gaming is set to undergo an exhilarating revolution.

Learning to remain calm and unflustered under pressure is an essential skill for playing traditional poker, however nowadays it's easy to hide your true emotions behind the safety of a computer screen.



Blood, sweat and tears: Can tech put the human element into online poker?

Using our proposed technology, poker players could gain unprecedented access to their opponent's state of mind (and body) during online gameplay. Signals such as increased heart rate, higher blood pressure and even pupil dilation can offer unique insights to online poker players about how their competition is feeling. But of course - there's a catch. To play this new high stakes game of poker, you also have to be prepared to have your vitals measured and shared.

Seasoned players may have perfected their poker faces and be adept at using a well-timed check, bet or raise to bluff to their opponents, but now it's time to truly test those nerves of steel.

This study aims to examine the viability of the available technology - looking at measurable stress responses, any form of relevant existing technology, and what are the potential variables.

How the body responds to stress

Experiencing stress goes hand in hand with playing poker. There's lots at stake, and the odds don't always hang in your favour. There are a number of physiological responses triggered in high stress situations. These measurable elements are known as **biomarkers** and are substances which can be used to tell researchers about the state of a specific human body.

The physiological reaction to stress is known as the fight or flight response (1), or hyperarousal, and is rooted in our desire to survive. In Neanderthal times, the stress response was a necessity for everyday life. When something unexpected happened - for example a predator suddenly appeared - the instant surge of adrenaline, cortisol and norepinephrine would offer vital energy to either fight or run away - fast.

When 'under attack' the body's immediate physical response is triggered by the *hypothalamus*, which is part of the central nervous system, and includes increased heart rate, constricted blood vessels (resulting in high blood pressure), tightening of the muscles and a faster rate of breathing.

Today, humans still experience the fight or flight response, although the stimuli is usually somewhat less life-threatening than it may have been for our ancestors. Running late for work, racing to meet a deadline or sending an inappropriate text to the wrong person can all leave us sweaty palmed and ready to run for the hills. However that's not to say the fight or flight response is without its merits.

While long term stress can have a negative effect on overall health, in short, sharp bursts it actually helps us perform better and remain focused on the task at hand. The boost of energy can help us respond immediately to a situation - such as performing an emergency stop in the car, *or quickly reassessing your strategy in a high stakes game of poker.*

Aside from the main indicators of stress, there are some less obvious physiological changes that indicate when someone is under pressure.

Sweat Biomarkers

According to scientists, there are in fact two different types of sweat. One type we produce when we physically exert ourselves - such as taking exercise - and is generally quite watery and designed to cool our bodies down. The other is a more pungent concentration of fatty acids, lipids and proteins which are released from the apocrine glands in high pressure situations. Although there is no solid scientific reason for the release of the unpleasant aroma, some theories suggest it is a warning signal to our peers that something dangerous is occurring or about to happen.

But how can we use a biomarker to measure perspiration, or detect heightened stress?

Ramsey Markus, M.D, Associate Professor of Dermatology states:

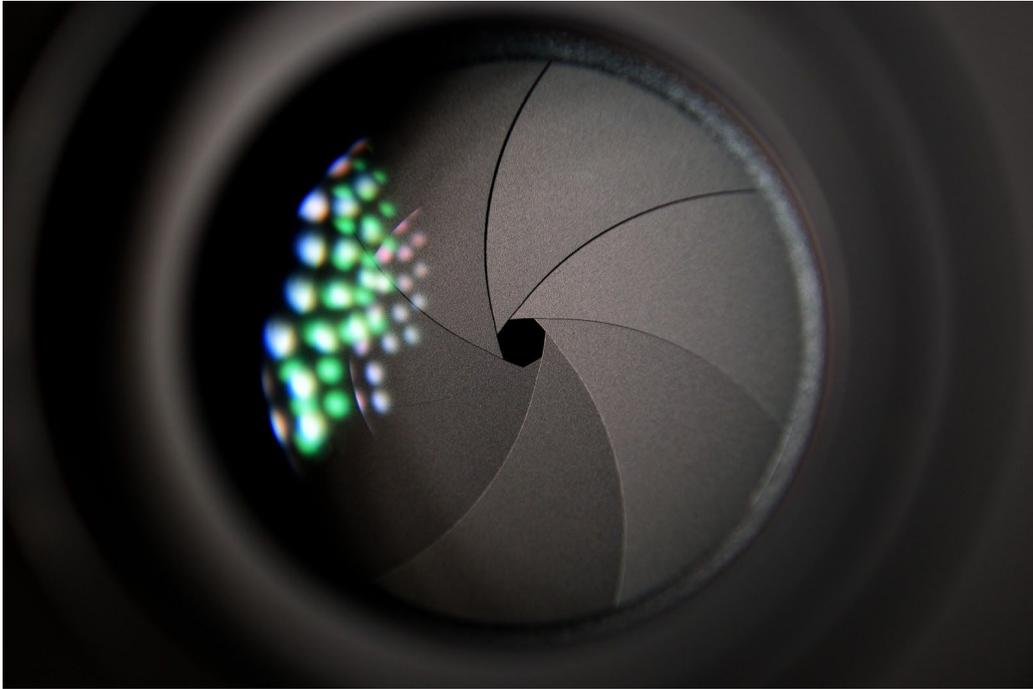
“Stress and exercise sweat are both triggered by the sympathetic nervous system. The real difference is that during exercise the body gets hot from the heat produced by muscle action whereas just being under stress doesn't lead to that. The heat of exercise in turn triggers extra eccrine sweat (the watery sweat) which is why you see athletes soaked from sweat during exertion.”

“This is important as the evaporation of sweat cools us off a bit so we don't overheat as easily. Also I believe this large amount of sweat washes out the apocrine sweat (which leads to the odor) which is why often athletes who are really sweaty don't have the same smell as someone who didn't bathe or under emotional stress (unless the athlete just smelled bad to begin with).”

“So if you want to differentiate between stress sweat and exercise sweat you could take a temperature. That's why a "cold sweat" is associated with stress. There is less eccrine sweat compared to exercise sweat so you can smell more odor from the apocrine gland secretion that's broken down by bacteria leading to smelly compounds. If you could create an odor sensor that might help but I'm sure some gamers might be less cleanly than others.”

He adds:

“Still measuring sweat production, heart rate, pupil size, sweat production all could indicate stress if you wanted to measure it. Also the GI tract slows, the mouth gets dry, blood pressure goes up, blood flow to muscles increases, blood flow to organs not necessary for activity decreases (the reason for less ability to urinate, defecate or have an erection during exercise or stress).”



The windows to the soul: Pupil Biomarkers

Studies have found they can also give a pretty clear indication of our mental and emotional state (2). While pupils dilate and constrict depending on exposure to light, there are a range of psychological stimuli which can provoke a response too - albeit a little more subtle and less pronounced response to that induced by changes in light, making it harder to measure. Feeling a sense of attraction or liking the look of something (from a chocolate cake to an attractive person) can cause pupils to dilate. Likewise increased brain function, such as when someone is lying (bluffing in a game of poker, for example), can result in larger pupils. Blink rate is also affected by lying - the rate slows down as they lie is being constructed, only to speed up during the act of lying itself.

Vocal stress is another strong giveaway that the autonomic nervous system has kicked in. The vocal chords constrict, causing higher than normal pitch. In saliva, the level of *cortisol* - also known as the stress hormone - another biomarker to show the subject is experiencing release of the stress response.

An additional side effect of stress is the liver producing more blood glucose to give an extra boost of energy. Stress also activates the immune system, which can be useful for dealing with immediate threatening situations.

Short term stress can trigger a range of physiological responses in the human body, as outlined. These responses are designed to help us deal appropriately with tricky situations as they occur.

It should be noted that continued exposure to short term stresses can make you more susceptible to long term stress, which in turn can have a lasting, detrimental effect on health.

In addition to physiological responses, there are other cues face to face poker players rely on to tell when one of their opponents is getting hot under the collar.

Nervous twitch?

The term micro expression is used to describe a fleeting facial expression that usually only lasts 1/125th of a second and occurs when an individual is trying to conceal their true inner emotions (4). Good poker players rely on a knowledge of body language to sus out when the competition is bluffing, and even better poker players use their body language to completely confuse the opposition. Common signs of lying include self-pacifying gestures such as rubbing hands together, hair or face stroking, or fidgeting. Likewise, crossed arms and other 'defensive' stances are a sign someone has something to hide.

With such a plethora of stress indicators at play, it should - in theory - be fairly straightforward to utilise modern technology to aid poker players in a game of online poker.



Using technology to monitor for signs of stress

Some biomarkers are easier to monitor than others. Realistically speaking, testing a subject during a game of online poker cannot be too invasive, such as taking blood samples. Plus the results would need to be available relatively quickly to convey the information to other players in the game. Other stress indicators, such as defensive body language, may also be difficult to monitor remotely and without human interpretation.

Of the biomarkers outlined; pupil dilation, heart rate, respiration rate, blood pressure and sweat may be the most appropriate to measure during a game of poker. Let's examine how each of these biomarkers could be monitored and measured.

Firstly, changes to pupil size could be measured during an online poker game via a **pupillometer**. Pupillometers are portable infrared devices which provide an objective measurement of pupillary size and reactivity. The device is able to track changes to pupil size and work out overall trends in the subject - thus eliminating external factors such as light and distance. In theory, a pupillometer could flag up changes to pupil size at various points during a poker game and relay this information to other players.

However, changes in pupil size when bluffing can be as little as less than half a millimeter, and some studies have shown pupil changes are even less pronounced in those with a higher IQ (3) - therefore this approach poses some obvious challenges.

Heart-rate

Heart rate is a somewhat easier biomarker to observe. There are a number of simple and inexpensive ways to measure heart rate. The three most viable ways to measure heart rate during an online poker game would be via a chest strap monitor, wrist monitor (like a FitBit for example) or headphones used for in-ear measurements. In terms of comfort and convenience, a wrist device is likely to be the most appealing option. However a chest strap offers the advantage of measuring more than one biomarker at a time - as it could also be used to measure respiration rate. There are a range of existing wearable devices available to help monitor these biomarkers simultaneously, such as the [Spire](#), the [BioPatch](#), and the [Bioharness](#).

Checking for increases in blood pressure in poker players is relatively straightforward with a digital blood pressure monitor. The monitor wraps around the arm and could be set to take regular readings throughout a game in order to identify and unusual peaks. And finally, adding a sweat monitor into the mix would add another valuable biometric into the overall reading. Sweat monitors have been historically used to test for certain conditions like cystic fibrosis and even nutritional deficiencies. But recently a [wearable smart patch](#) has been developed which can send updates on the state of your body straight to your smartphone.

Running simultaneously, these devices - pupillometer, heart rate and respiration rate monitors, blood pressure checkers and sweat monitor - will offer a well-rounded picture of the subject's state of mind throughout a poker game. In testing, players will be placed in high stress situations, such as: receiving a very good or bad hand, winning or losing a large amount of cash, exposure to external stimuli such as high temperature or loud noises, or experiencing conflict with another player. In theory, the biomarkers in our prototype would change significantly and we can accurately identify moments of strain.



Communicating biomarkers throughout the game

Once identified, the biomarkers will be communicated to the other online poker players in a game. This is where haptic technology comes in.

Haptic technology generally relates to a sense of touch. Most commonly found in video gaming through rumble packs or in the vibrations of a mobile phone, haptic technology holds a wealth of potential for online gaming in the future. Imagine being able to feel your opponent's racing heartbeat or experience them shifting uncomfortably in their chair. We're hoping our prototype will offer a new dimension into the world of online gaming - by distinctly adding a 'human' element back into the game.

Studies have shown haptic technology can simulate different types of touch via high speed vibrations. The latest technology is able to communicate distinct shapes, textures and resiliencies to indicate a range of elements to the wearer.

Some examples of existing technology which use this approach are [Chai3D](#), [OpenHaptics](#), and the Open Source [H3DAPI](#). *Heartbeat, pressure, quickened breathing and expanding pupils* could all be communicated to a player and their opponents via a simple, yet sophisticated, wearable device - such as a wrist band.

Considering the variables

In testing, a number of variables must be considered. From human intervention to external influences, it is important to look at what factors may affect the accuracy of reading and communicating the biomarker results.

Firstly, could player's cheat the system? It isn't unheard of for unscrupulous individuals to try and get the upper hand in a game of high-stakes poker via dishonest means. Aside from getting one of their friends to sit next to them and wear the device without actually paying attention to the game (therefore delivering unremarkable responses) - are there other ways they could control the aforementioned biomarkers?

Studies have shown that mindfulness meditation can have a direct impact on the sympathetic nervous system, responsible for increased heart rate (5). This also has may decrease the stress hormone, cortisol. These factors can contribute to keeping the physical response to stress in check. In fact, practising meditation for just 8 weeks can improve an individual's resilience to stress.

In order to control pupil size, players could employ a range of substances, including alcohol or illegal drugs such as cocaine. However playing under the influence is an unlikely option for a poker player determined to win. Eye drops such as Cyclogyl are used by opticians when carrying out eye exams, and can keep pupils dilated for 4 to 24 hours. Finding access to such drops may prove tricky and using them without professional guidance poses significant risk.

Aside from players' intervention, external factors, such as room temperature or loud noise, may also influence the player's responses.

There are also a range of other factors to consider which may affect the biomarkers, such as age, lifestyle, health, sleep patterns, diet and other factors which vary between individuals. For this reason it would be necessary to establish a baseline for each player before the poker game commences.

Much like a traditional lie detector test, the subject would be asked several 'neutral' questions with some difficult questions thrown in to measure their stress response. During this introductory section their biomarkers would be monitored and a 'normalised' heart rate, respiration rate, blood pressure and pupil size could be established for them on an individual basis. This baseline would then be used throughout the ensuing game to measure any remarkable changes to their own specific level of biomarkers - giving a more reliable indication of when the subject may be under stress.

Conclusion

Biofeedback combined with haptic interaction would create a powerful instrument for players as it would essentially enhance player performance.

Real-time monitoring would provide instant feedback on the physiological changes that occur in the player and the pressure of the game would allow individuals to observe and control their own anxiety and stress levels through sensory activity. Being able to feel an opponent's stress level rise or fall, and learning to control your own stress response will add a fascinating human element into what has thus far been a particularly detached activity.

In particular, the proposed wearable technology will allow individuals to pay attention to biomarkers such as heart rate, pupil size and sweat production to ultimately, test their own resilience via the convincing illusions that haptic technology is able to produce.

The limitations that exist in the first part of our research includes the fact that some vital biomarkers are considered protected health information in some U.S states. The second is that professional guidance would be required as per our scientific consultants' feedback on the system. However for now, Casingdom LABs intends to take the research and theories laid out here and create a prototype of the device and commence testing on real life subjects.

We will rely on the feedback from the poker community during the next phase of development, specifically on which form would the proposed technology would take, and how to integrate it in a way that's non-intrusive.

*This study also exists as a blog post on the main Casingdom site:
<http://www.casingdom.com/biofeedback-concept-using-haptic-technology/>*

Sources

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