

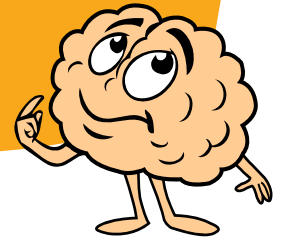
BRAIN CONNECTIONS:

PROBLEM GAMBLING SERIES



This project was sponsored by Gambling Research Exchange of Ontario and the Ministry of Health and Long-Term Care
This handout is designed to be used as a clinical tool to enhance problem gambling treatment and is provided as-is.

HOW IS PROBLEM GAMBLING LIKE AN ADDICTION TO ALCOHOL OR DRUGS, FROM MY BRAIN'S POINT OF VIEW?



Imagine, for a moment, a car. The Reward Network in your brain is like the gas pedal in your car. It gives the 'GO!' signal to move towards something you want – there may even be a thrill as you press the gas. The Top-Down Control Network, on the other hand, is the brake pedal in your car. It gives the 'STOP!' signal that tells you to stop what you are doing. Some researchers describe addiction as being a problem with both the Reward and Top-Down Control Networks (your gas pedal and brakes).

Studies show that both people with gambling problems and people with substance use problems have inconsistent 'pedals' and 'brakes'. To understand what is happening in the brain, we must look more carefully at these two networks:

THE REWARD HUB – 'GO!'



The Reward Network is made up of different brain regions that talk to each other. The **Ventral Striatum**, also known as the '**Reward Hub**' (see *Figure 1*), is an important part of this network. The Reward Hub's job is to help us gauge when a reward might come our way. It recognizes the cues that predict a reward. Normally, the Reward Hub 'lights up' (activates) when it anticipates a reward (for example, the smell from the kitchen when your favourite meal is cooking, your dog or cat coming to the door to greet you at the end of the day or getting dressed up for a social activity you have been looking forward to). However, recent analysis of brain imaging studies comparing people with substance addictions and people with gambling problems (see *Figure 2*) shows that both groups have less activity in the Reward Hub, compared to people without addictions when it comes to anticipating rewards¹.

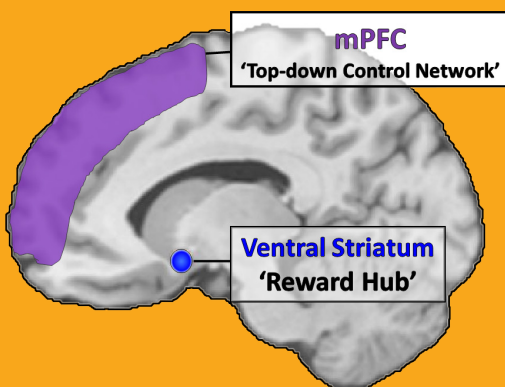
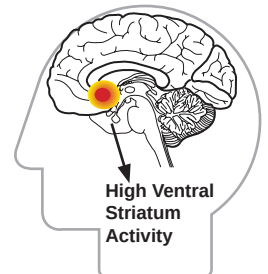
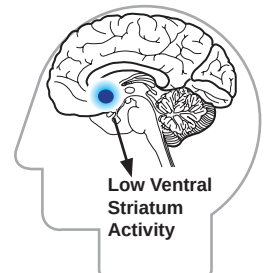


Figure 1

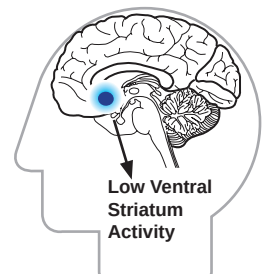
What this means is that people with addictions don't process rewards in the same way. They may not be as excited by natural rewards. They might also have trouble learning how new experiences, such as taking up a hobby for the first time, could be enjoyable. That is why some people might seek out unnatural rewards (like gambling, alcohol or drugs) just to feel pleasure or to escape. But doing this can push the 'GO!' pedal to the extreme and may override the brake system.



Person with No Addiction:
High Reward Hub Activity
When Anticipating Reward



Person with Problem Gambling:
Low Reward Hub Activity When
Anticipating Reward



Person with Substance
Use Disorder:
Low Reward Hub Activity
When Anticipating Reward

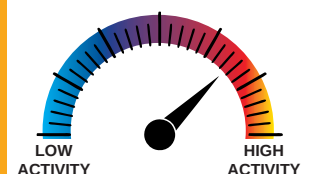


Figure 2

¹ Luijten et al., (2017). *JAMA Psychiatry*, 74(4), 387-398.



The Top-down Control Network acts as the 'brakes' to the Reward Network. Brain areas like the **medial Prefrontal Cortex (mPFC)** (see Figure 1), also known as the '**Top-down Control Network**', are involved in paying attention and stopping a response – this is called 'inhibition'.

As you can imagine, brakes that work well would be very important when we are pushing the gas pedal to the extreme, as happens in problem gambling. The research tells us that the brakes amongst problem gamblers do not work very well. In one study², for instance, researchers scanned the brains of individuals who are told to press a button as quickly as possible when they see a 'GO!' signal (e.g. a green light) and then see what happens in the brain when they get a 'STOP!' signal (i.e., how quickly can they stop themselves from hitting the 'Go' button when they see a red light?). These studies show brain differences in people who have an addiction when they get a 'STOP!' signal.



Specifically, this study compared three groups²: (1) individuals with problem gambling, (2) heavy smokers and (3) individuals with no addictions at all. The researchers discovered two things about the individuals with either a gambling or smoking addiction (see Figure 3). First, they show less activity in the Top-Down Control Network during a 'STOP!' signal. Second, their brakes don't work very well – they pay less attention to the 'STOP!' signal and are less able to 'put on the brakes'. In addition, the researchers also noticed that the more severe the gambling problem, the less activity is seen in the Top-Down Control Network. So, the more addicted you are to gambling, the less well your 'brakes' will work and the more problems you could have engaging your Top-down Control Network when gambling. This means that once you start gambling, it can be hard to stop (but not impossible!).

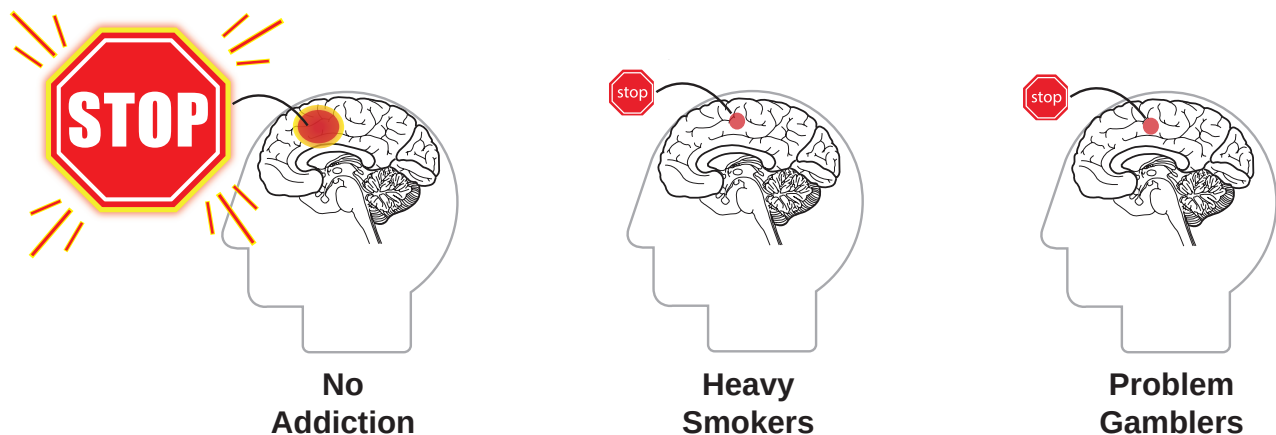


Figure 3 USING YOUR mPFC TO STOP SUCCESSFULLY: When given a stop signal, heavy smokers and problem gamblers show less activity in the Top-down Control Network.

ACTIVITY: 'REWARD HUB' OR 'TOP-DOWN CONTROL NETWORK'?

Which part of the brain do you think is responsible for each statement below?

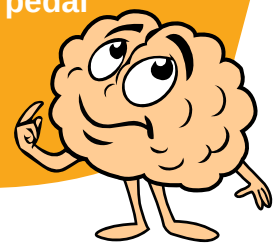
1. I said 'no' to a gambling urge. _____
2. I'm imagining how I will spend my gambling winnings. _____
3. I really want to gamble right now – I think I'll just take \$20. _____
4. I want to gamble but I know that's a bad decision so I won't go. _____

1. TOP-DOWN CONTROL NETWORK; 2. REWARD HUB; 3. REWARD HUB; 4. TOP-DOWN CONTROL NETWORK

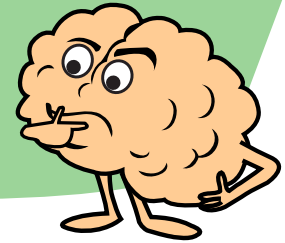
GOING FURTHER:

How do you think your 'pedal' and 'brakes' have been affected by addiction? For example, do you find it harder to say 'no' to things that you know are not good for you? Do you have difficulties with boredom? Do you feel like nothing will ever be pleasurable for you again? What natural rewards or new experiences could you try in the next few days?

TAKE HOME MESSAGE: When anticipating rewards, the 'GO!' network can show less activity in people with addictions. This means that they might seek out unnatural rewards to activate the 'GO!' network and push the gas pedal to the extreme. This is why people with an addiction may not be as excited by natural rewards and they might also have trouble learning how new experiences could be enjoyable. In addition, people might not notice the need to stop an addictive behaviour and, even if they do, their 'brakes' may not work as well. Nonetheless, the 'GO!' and 'STOP!' networks can change how they respond to natural rewards. **The good news is that the brain is always changing. Keep rewarding yourself with natural, healthy activities in moderation. Repeat these activities because it will take time for your brain to find pleasure again. Avoid unnatural rewards that could wear out your pedal and brakes.**



WHY DO PEOPLE KEEP GAMBLING EVEN WHEN IT'S NOT FUN ANYMORE?



Have you ever wondered why people who have a gambling problem continue to gamble even though they don't like it and don't want to do it anymore? Here, we'll describe what parts of the brain are involved in keeping a habit like gambling going, even when it's no longer enjoyable.

THE REWARD NETWORK

In our brains, we have a Reward Network that includes two important parts – the Ventral Striatum and the Dorsal Striatum (see *Figure 1*).

The **Ventral Striatum**, also known as the '**Reward Hub**', allows us to experience pleasure. The Reward Hub lights up when we want something or when we anticipate that something will be rewarding. The Reward Hub is much like the gas pedal in a car. When gambling becomes a problem, it's like we keep pressing that gas pedal to the extreme in order to feel pleasure.

The **Dorsal Striatum**, also known as the '**Habit Hub**', helps us to establish habits. When we over-engage in pleasurable behaviours, brain activity shifts from the Reward Hub to the Habit Hub as a habit is formed. These two parts of the brain normally work together in harmony. This way we can experience pleasure, but also quickly develop habits out of these experiences so that we can repeat them.

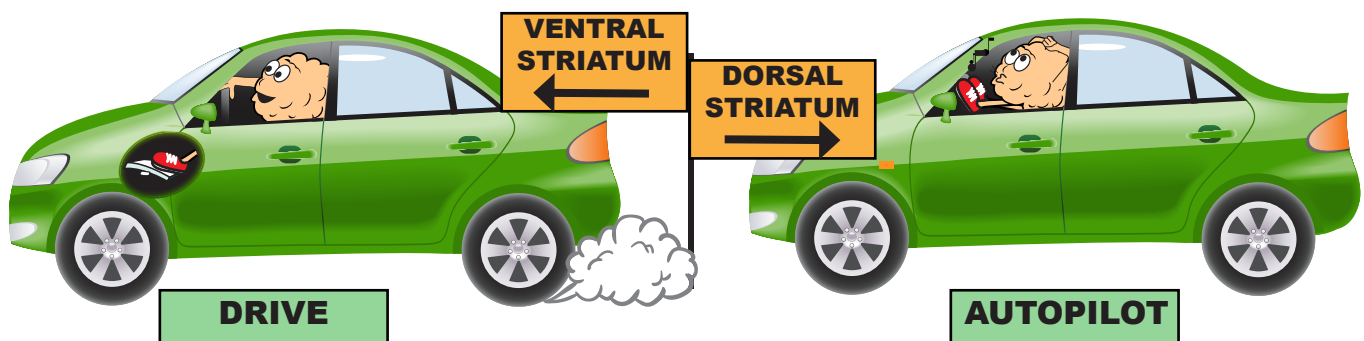


Figure 2

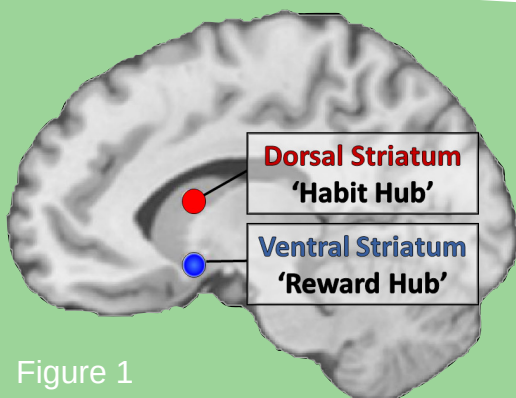


Figure 1

When gambling becomes a problem, researchers believe that the Reward Hub and the Habit Hub stop working together harmoniously. The gas pedal gets pressed too much and, all of a sudden, we are now in the habit of gambling. This change in the brain results in three things: (1) people with gambling problems become overly aware of gambling cues, (2) this over-awareness causes strong urges to gamble; (3) but when people actually gamble, they will feel less pleasure in gambling because it is now a habit. Let's take a closer look at these discoveries.

LESSONS FROM SUBSTANCE USE RESEARCH

Much of what we know about the shift from the Reward Hub to the Habit Hub comes from research in the field of substance use. Researchers find that the brain rapidly associates specific stimuli (such as seeing alcohol or drugs) with reward ^{1, 2}. For example, if someone with an alcohol use problem sees a bottle of wine, she associates past feelings of pleasure or reward with the wine and will want to drink it. This pleasurable association has been formed over many drinking occasions and is so strong that it can override other thoughts about why she should not drink.

The same thing can happen with a gambling problem. As a person gambles, she starts to associate gambling cues (e.g., the sounds of a slot machine, the feel of felt on a poker table, her favourite numbers) with a reward, such as money. She likes the feeling she gets with the reward, so she gambles again and again to feel that pleasure. She keeps pressing the 'gas pedal,' lighting up the Reward Hub.

GETTING IN THE HABIT

So, why doesn't the pleasure of gambling last? Because the brain quickly learns what it needs to do in order to get a reward. And, as behaviours become well-learned, engaging in them no longer lights up the Reward Hub. Instead, the Habit Hub is activated³. Once a behaviour becomes a habit, it is almost automatic – we don't really have to think about it anymore and it is not as pleasurable as it once was. Not only is gambling less pleasurable when the Habit Hub is in charge, but it is also more likely that one's attention will be hijacked by gambling cues (see *Figure 3*). For example, people with gambling problems are faster at recognizing gambling-related cues compared to neutral ones⁴. This explains why someone with a gambling problem would more quickly notice an advertisement for a new casino than one for a new restaurant.

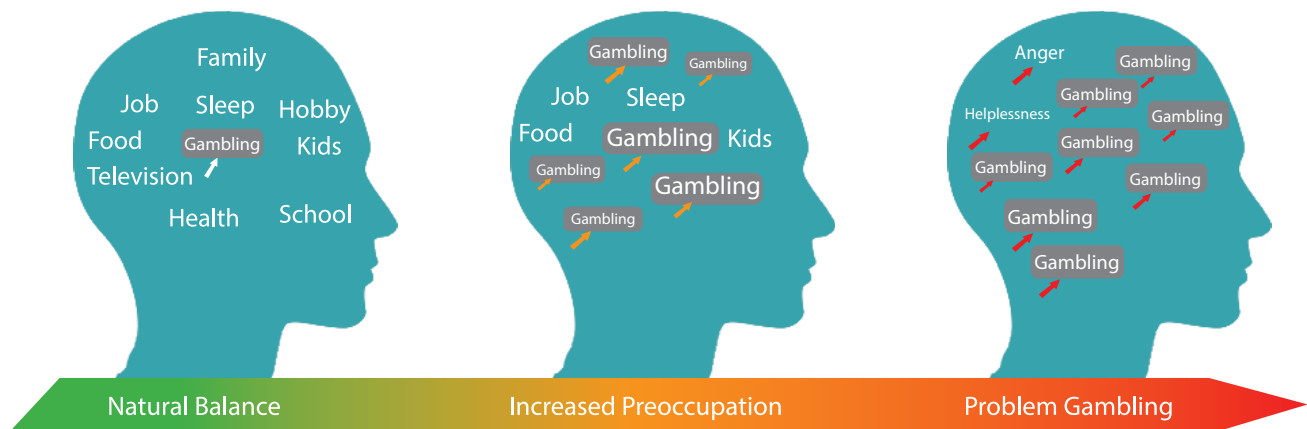


Figure 3 INCREASED ATTENTION TO GAMBLING CUES AS PROBLEM GAMBLING DEVELOPS.

¹ Everitt & Robbins (2005). *Nature neuroscience*, 8(11), 1481-1489.

² Robinson & Berridge (1993). *Brain research reviews*, 18(3), 247-291.

³ O'Doherty et. al., (2004). *Science*, 304(5669), 452-454.

⁴ Brevers et. al., (2011). *Psychology of addictive behaviors*, 25(4), 675; Brevers et. al., (2011). *Journal of behavior therapy and experimental psychiatry*, 42(3), 265-269.

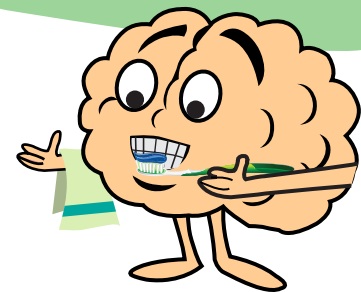
LIKING AND WANTING

When gambling becomes a habit, gambling cues are processed faster and they trigger very powerful urges to gamble.

Consider this example: if you have a gambling problem, just seeing money can be a trigger to gamble. As shown in Figure 4, when gambling becomes a habit, there is a switch from 'liking' to 'wanting'. This switch happens when the Habit Hub overrides the Reward Hub. At this point, you want to gamble (your Habit Hub is active) but you don't even like it anymore (your Reward Hub is weakened). People in problem gambling treatment often experience this effect – they feel a strong desire to gamble but it is no longer for fun or entertainment. Instead of feeling pleasure, gambling is used to ease the discomfort of urges.

SOME HABITS CAN BE GOOD

You might wonder why the Ventral-to-Dorsal Striatum shift happens at all, especially when bad habits or addictions can be so damaging. The reason is that many habits can actually also be good for us, providing mental shortcuts so our brains can focus on other things. For example, as children, we quickly learned how to brush our teeth and it was fun. Now, as adults, brushing our teeth is fairly routine and automatic. This habit is a healthy shortcut – consider all the other things your brain was freed up to think about while brushing your teeth this morning!



Gambling Effects on the Brain

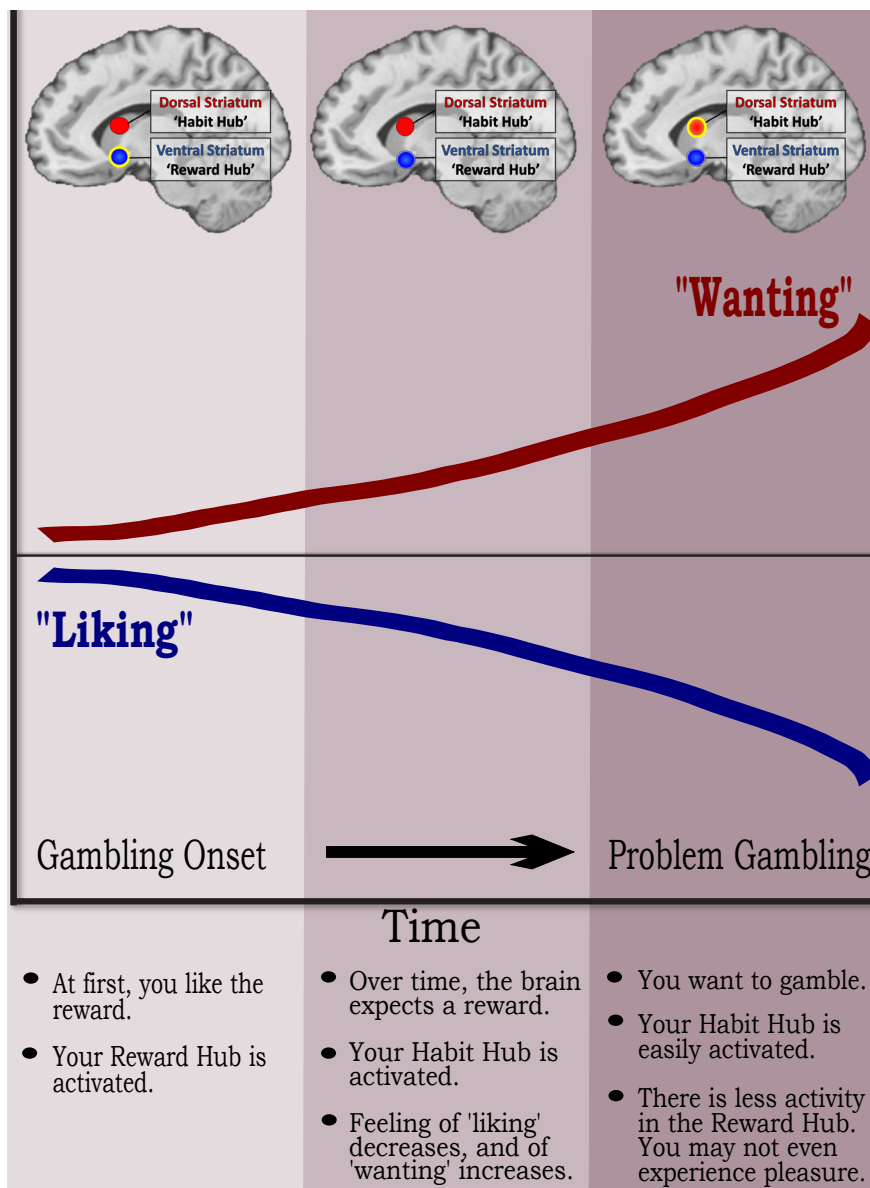


Figure 4
THE SHIFT FROM 'LIKING' TO 'WANTING'.

Initially, gambling is pleasurable but, over time and with increased gambling, the feeling of 'liking' decreases and the 'wanting' takes over.

ACTIVITY:

Can you see at what point the Habit Hub overrides the Reward Hub?

1. "This is my first time gambling – that was a fun night out!"
2. "I've gambled a few times this month and I'm excited to go again, whenever that might be."
3. "I gamble every Friday night – it's my main fun for the weekend."
4. "I have been gambling every day for months... it's not really fun anymore and I'm not sure why I'm still going."
5. "I hate gambling but I feel like I can't stop. The urges are so strong."

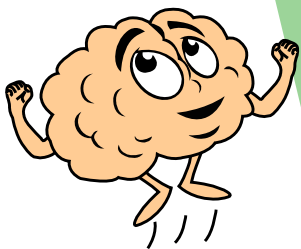
Answer: The third statement is the beginning of the Habit Hub override because gambling is now a habit. As the person keeps gambling habitually, gambling becomes less fun but there are still strong urges to keep going. By statement 5, the Habit Hub is in control.

GOING FURTHER:

Can you relate to wanting to gamble even if you don't like gambling anymore? Based on what you learned here, what can you tell yourself in order to get through an urge to gamble?

Why is it helpful to avoid gambling cues (e.g., seeing a gambling ad on TV) early on in treatment?

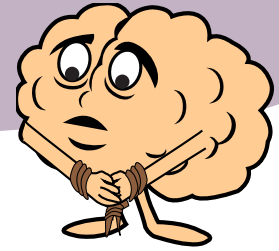
What good habits would you like to develop in your life?



TAKE HOME MESSAGE: As a person develops an addiction problem, there may be a shift in brain activity from the 'Reward Hub' to the 'Habit Hub' and a shift from 'liking' to 'wanting'. A person may want to gamble and not even like it anymore. The brain is also overly aware of the gambling cues which can trigger powerful urges to gamble. But gambling won't feel as fun as it used to because gambling is now a habit and habits don't give us the same pleasure as new experiences. Instead, gambling might have become a way to ease the discomfort of strong urges. **The good news is that our brain learns quickly, so over time we can form new associations to help develop healthy behaviours that we find pleasurable.**



WHY IS IT HARD TO SAY 'NO' TO A GAMBLING URGE?



When people make a change to their gambling behaviour, it is very common for them to have urges to gamble. Even the most committed person can still struggle with urges. Saying 'no' to an urge is not as easy as it sounds. Let's read on to explore what happens in the brain to cause these urges.

WHAT PARTS OF THE BRAIN ARE INVOLVED IN URGES? AN OVERVIEW.

There are multiple parts of the brain that are involved in urges. We will talk about three main parts here. The first part is your brain's **Attention Network** (including the Habit Hub and the dorsal Anterior Cingulate Cortex (dACC)). It can become overly-sensitive to gambling cues. For example, people who have gambling problems are far more likely to notice gambling commercials, signs for gambling establishments, or even the look and feel of money.

At the same time that the Attention Network is processing all these cues, it may not be communicating with other areas of the Top-down Control Network. The dACC and the medial Prefrontal Cortex (mPFC) - which are both part of the Top-down Control Network (see *Figure 1*) - may not be talking very well to each other. If communication is poor between these two areas it means that people may have difficulty 'putting on the brakes' when faced with a gambling urge.

The third part of the brain involved in urges is the **Insula** (see *Figure 1b*). The Insula is responsible for processing physical sensations and emotions (including urges). It will also drive you to want to do something about those urges (i.e., go gambling to ease the discomfort). With so many parts of the brain involved in gambling urges, they can feel like powerful, full-body experiences that hold your attention hostage.

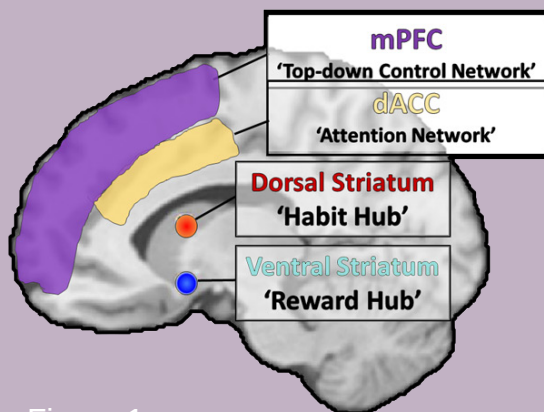


Figure 1

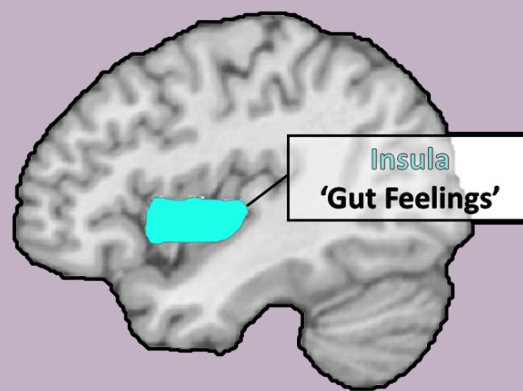


Figure 1b

IT MATTERS HOW WE UNDERSTAND GAMBLING URGES

Urges are crucial to the development of addictive behaviour and relapse. So, it is very important to understand how and why gambling urges occur.

Urges are a key reason why gambling problems happen in the first place. When experiencing urges, one way to alleviate their discomfort is to 'gamble them away.' The more often this happens, the more likely a gambling habit will form. Gambling urges are also a major reason why people relapse and why they drop out of treatment. Strong urges can happen at any time and people are not always prepared for them.

Relapses occur and sometimes a desire to quit treatment follows. The better we understand urges, the more prepared we can be when they come and the less upsetting they are to our lives.



URGE SURFING

Urge surfing is a term counsellors use to describe coping with urges, which rise and fall like waves. To avoid gambling, do what a surfer would do: pay close attention to the wave (the intensity, the movement, your emotions), be flexible in your response and stay focused on your goals.

Every urge comes to an end and it is your Top-down Control Network that can help you get safely to the shore.



WHAT'S HAPPENING IN THE BRAIN WHEN YOU HAVE AN URGE?

So, why doesn't the pleasure of gambling last? Because the brain quickly learns what it needs to do in order to get a reward. And, as behaviours become well-learned, engaging in them does not light up the 'Reward Hub'. Instead, the 'Habit Hub' is activated. Once a behaviour becomes a habit, it is almost automatic – we don't really have to think about it anymore and it is not as pleasurable as it once was.

One way researchers study gambling urges is by exposing people to gambling cues and then observing the brain's responses. Brain scans show that when exposed to gambling cues (e.g. watching videos of other people gambling, seeing pictures of gambling or hearing gambling sounds), people with gambling problems report increases in gambling urges^{1, 2, 3}. We can also see changes in activity in their Top-down Control Network, which includes the mPFC and dACC.

We saw in Handout 1 (How is problem gambling like an addiction to alcohol or drugs, from my brain's point of view?) that the mPFC is involved in paying attention and stopping a response. The dACC is a close neighbour to the mPFC. Its main functions are directing your attention, noticing when things are going wrong, and regulating emotions. It's almost as though this area lights up to say: "I'm noticing that something is not right. Let's see what other brain areas I can contact to do something about this..." The dACC is very important because it can draw attention to the discomfort of an urge and potentially nudge its neighbour, the mPFC, to stop or change direction.

¹ Potenza et. al., (2003). *Archives of general psychiatry*, 60(8), 828-836

² Kober et. al., (2016). *Neuropsychopharmacology*, 41(2), 628-637

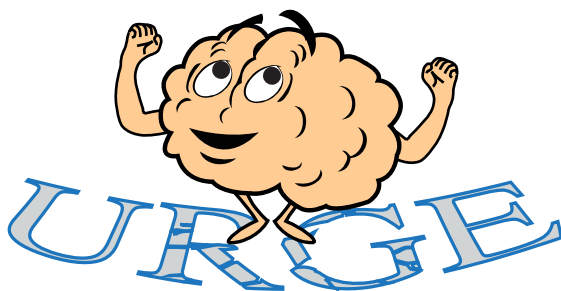
³ Limbrick-Oldfield et. al., (2017). *Translational Psychiatry*, 7(1), e992

People with gambling problems may show differences in how these brain areas talk to each other and to the Reward Hub. In a recent study, researchers showed participants cues tailored to their personal gambling preferences. For example, while they were in a brain scanner, if participants were sports betters, they were shown pictures of sports betting; if participants preferred roulette, they saw pictures of a roulette wheel³. Compared to people without an addiction, the problem gambling group showed increased activity in the dACC, in the Striatum but also in the Insula.

This means that the Reward Hub was engaged (the Striatum 'lit up'). It also suggests that the dACC may be paying more attention to these cues and trying to regulate the emotions around them. The emotions could be pleasure or discomfort depending on how the participant experienced seeing the cue. The Insula activity was directly related to gambling urges in the problem gambling group: the higher urges they reported, the greater activity was seen in the Insula. Essentially, the Insula was saying "You are feeling badly – go do something about that!" (i.e., gamble).

So, what's the bottom line? When exposed to gambling cues that increase their urges, people with gambling problems show more activity in all of these brain areas. This is how urges can take over: with all of your attention focused on a gambling cue and your brain highlighting negative body sensations, it can be really hard to say 'no' to an urge. Your whole body is consumed by the urge!

Here is the good news: there is a relationship between gambling urges and abstinence from gambling. The longer you go without gambling, the less urges you will experience even after seeing the gambling cues that normally trigger you. This suggests that brain changes are happening over time to make the attention networks less sensitive and reactive.



INTEROCEPTION

The Insula is an important brain area that is involved in interoception or 'gut feelings'. Interoception allows you to process sensations coming from your body, such as pain, temperature, itch, hunger, thirst and even the feeling of needing to breathe⁴.

The Insula combines these bodily sensations with emotions and a drive to do something about the signals it is receiving. Normally, the 'gut feelings' that come from the Insula actually help us to make good decisions. For example, when you see a dark alleyway, the Insula might signal 'don't go down there.'



However, in addiction, you may not be in tune with what the Insula is saying. You might not pick up the signal at all or you might misinterpret the signal. For instance, you pass by a casino and you start sweating. The Insula might say 'this is dangerous – stay away from the casino because bad things have happened here before.' But, you interpret the sweating as a need to go gambling or that a win is near.

⁴ Craig, A. D. (2003). *Current opinion in neurobiology*, 13(4), 500-505.

ACTIVITY:

Given what we just learned about the brain and responding to gambling cues, which of the following might put you at-risk for a gambling relapse or strong urges?

1. Watching someone else engaging in your favourite form of gambling.
2. Watching someone else engaging in a form of gambling you have never liked.
3. Engaging in a form of gambling that has not caused a problem for you before.
4. Listening to people talk about gambling wins.
5. Opening your wallet and seeing a large amount of cash.
6. Driving in the direction of your preferred gambling venue.
7. Having a great day and feeling invincible.
8. Having a really bad day and feeling like you'll never be in control of your life.

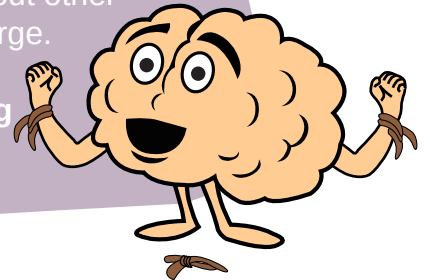
Answer: The answer depends on you! Each of these scenarios could trigger an urge to gamble. Be mindful of your responses to any potential trigger.

GOING FURTHER:

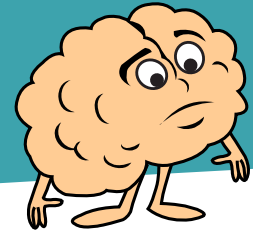
What are your triggers? Think about times when you have had an urge and what was happening just before. How did your body feel? What did you do about the urge? Would you do anything differently?

TAKE HOME MESSAGE: Saying 'no' to an urge is not always easy. This is because of changes in the brain that occur once gambling has become a problem or a harmful habit. Many parts of the brain are involved, including: the Striatum (which makes you overly-sensitive to gambling cues), the dACC and the mPFC (involved in attention and 'braking'), and the Insula (signalling gut feelings). This is why an urge can feel like a powerful, full-body experience and why willpower alone (without other strategies in place) may not be enough to stop you from acting on an urge.

The good news is that staying in treatment and abstaining from gambling can lead to fewer urges and less sensitivity to gambling cues. Talk to your counsellor about other strategies that might work best for you.



SINCE I'VE STOPPED GAMBLING, WHY DOES NOTHING ELSE FEEL FUN?



During early recovery, many people find that what used to bring them excitement or pleasure, no longer does. This is called **anhedonia** – the reduced ability to experience pleasure. Activities like going out with friends, watching TV, hobbies, eating food, or being with family don't seem very fun or exciting. Understanding and recognizing anhedonia is very important because high levels of anhedonia are linked to strong gambling urges as well as relapse.

Let's talk about why anhedonia might occur and what can be done about it.

CHANGING SETPOINTS

'Setpoints' are your natural mood states that can shift slightly with day-to-day activities. With addiction, though, natural setpoints can change¹. Setpoints are usually stable, but can change because of major or continual stressors. Stressors can include negative events like losing a job, but also new events such as a big gambling win.

Figure 1 shows us how, at first, gambling increases pleasure, but then a person returns to his natural mood setpoint. However, as he continues to gamble and experience ongoing stressors (getting into debt, hiding gambling), his setpoint drops. Now gambling doesn't bring as much excitement, but also his setpoint is lower even when he's not gambling. His setpoint could be so low that he may even be depressed. Consequently, getting pleasure from natural rewards would be difficult for him.

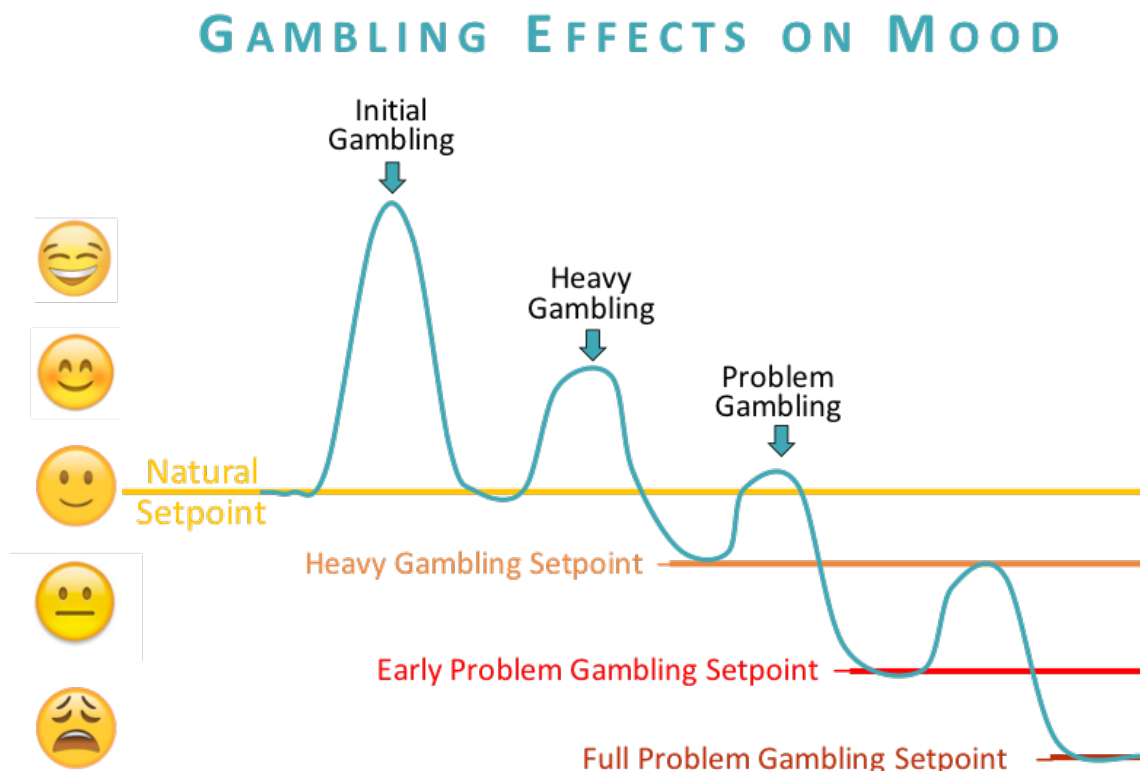


Figure 1

¹ Koob & Le Moal (2001). *Neuropsychopharmacology*, 24(2), 97-129.

Problem gambling can lower the mood setpoint so the rewards that used to give pleasure don't anymore. For example, a recent brain imaging study showed how people in early recovery from substance use respond to natural rewards. People who were recently abstinent looked at pictures of natural rewards while having their brains scanned. The researchers compared individuals with anhedonia and without anhedonia as they viewed pictures of delicious-looking food or positive social situations, such as having a happy dinner with family². People with higher levels of anhedonia showed less activity in the Reward Hub of the brain. This means that some individuals with anhedonia may have a reduced ability to feel pleasure from natural rewards like good food.

Another reason why experiencing pleasure is difficult for people with problem gambling is because the brain's Attention Network is still focused on gambling cues, and doesn't respond well to natural rewards yet (see *Figure 2*).

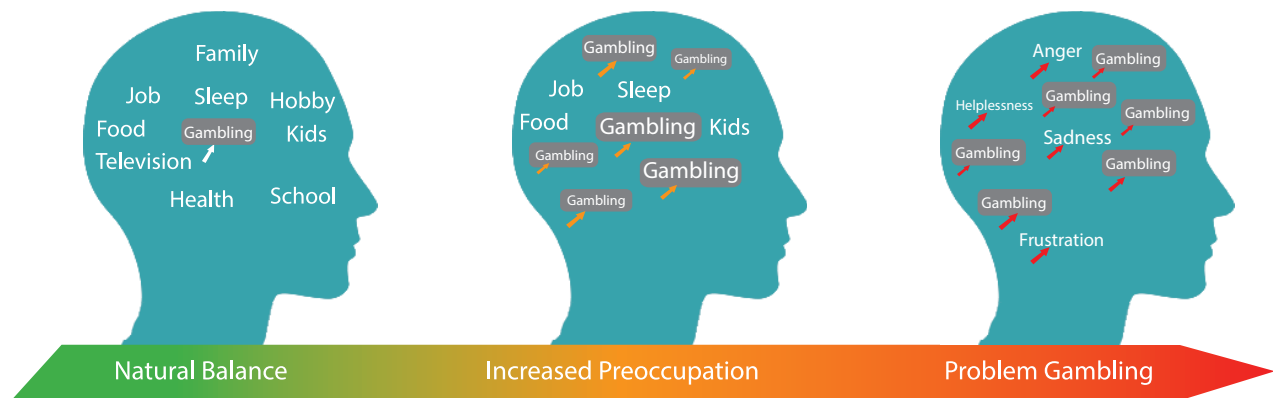


Figure 2

CHANGING SETPOINTS AGAIN

The brain is always changing and so can the setpoint (see *Figure 3*). Research on how the brain recovers from addiction is just starting, but so far, early findings look promising. For example, one study showed that after 4 months of abstinence, the brains of individuals with substance-based addictions respond to non-drug cues³.

These brain changes are seen in areas involved in reward, attention and inhibitory control. This is a positive sign for people with problem gambling. It shows that the brain can change its responses to non-addiction cues. The brain's Reward and Attention Networks that may have been altered in addiction can change again!

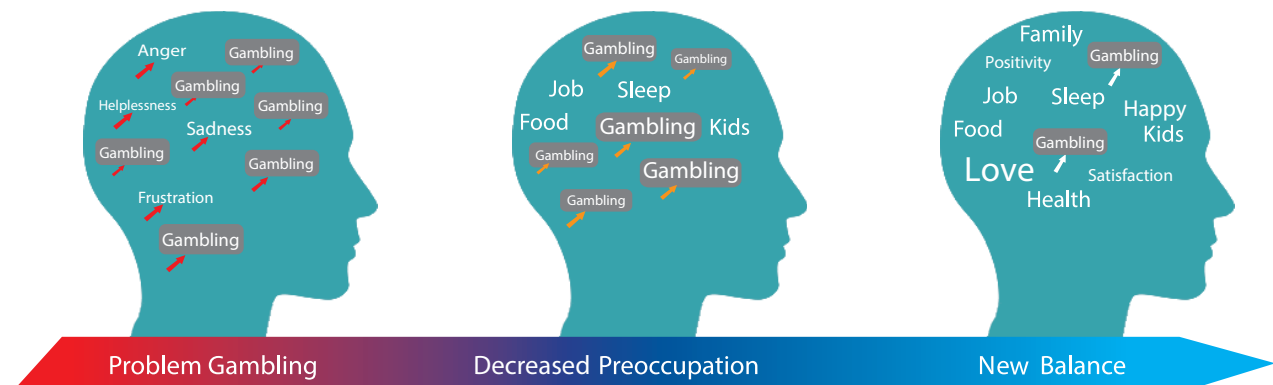


Figure 3

² Huhn et al., (2016). *Brain Research Bulletin*, 123, 102-109.

³ Balodis et al., (2016). *Neuropsychopharmacology*, 41(8), 2112-2121.

ACTIVITY:

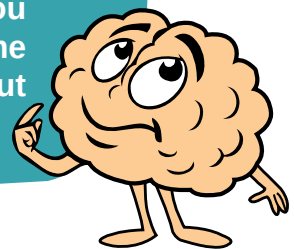
Reflecting on your own gambling history: What were some events or experiences that impacted your setpoint? List them here:

GOING FURTHER:

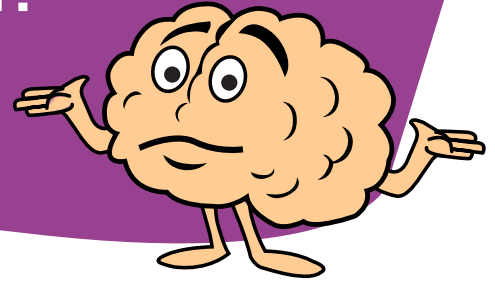
1. When gambling, what good and bad stressors have you experienced?

2. What activities previously brought you pleasure before you started gambling?
Can you think of some activities that you always wanted to do but gambling got in the way?

TAKE HOME MESSAGE: The early stages of recovery from problem gambling are associated with anhedonia, which is the reduced ability to experience pleasure. This is a sensitive time period when an individual may have a very low mood, high gambling urges, and experience little pleasure from natural rewards. **The good news is that the brain can also change again during recovery. You may start to enjoy natural rewards again. These improvements take time so it is important to keep practicing hobbies you enjoyed and trying out new activities.**



WHY DO PEOPLE SOMETIMES SWITCH FROM GAMBLING TO ANOTHER ADDICTION?



Switching from one addiction to another is called **substitution** or ‘**cross-addiction**’.

When people try to change an addictive behaviour, they can sometimes switch to another addiction or unhealthy behaviour in the process. For example, when a person stops gambling, he might find himself smoking more cigarettes, using marijuana, taking prescription painkillers or bingeing on certain foods. He might even increase behaviours that can have addictive-like qualities such as sex, exercise, work, gaming or social media. You may have been told in counselling to be careful about substitution. This is because many people have experienced a substitution that has been damaging and your counsellor will want you to watch out for that danger.

Even though substitution can feel like ‘common knowledge’ in the field of addictions, there has not been a lot of research into why it happens. Let’s turn now to what research we do have about the overlap between addictions (see *Figure 1*).

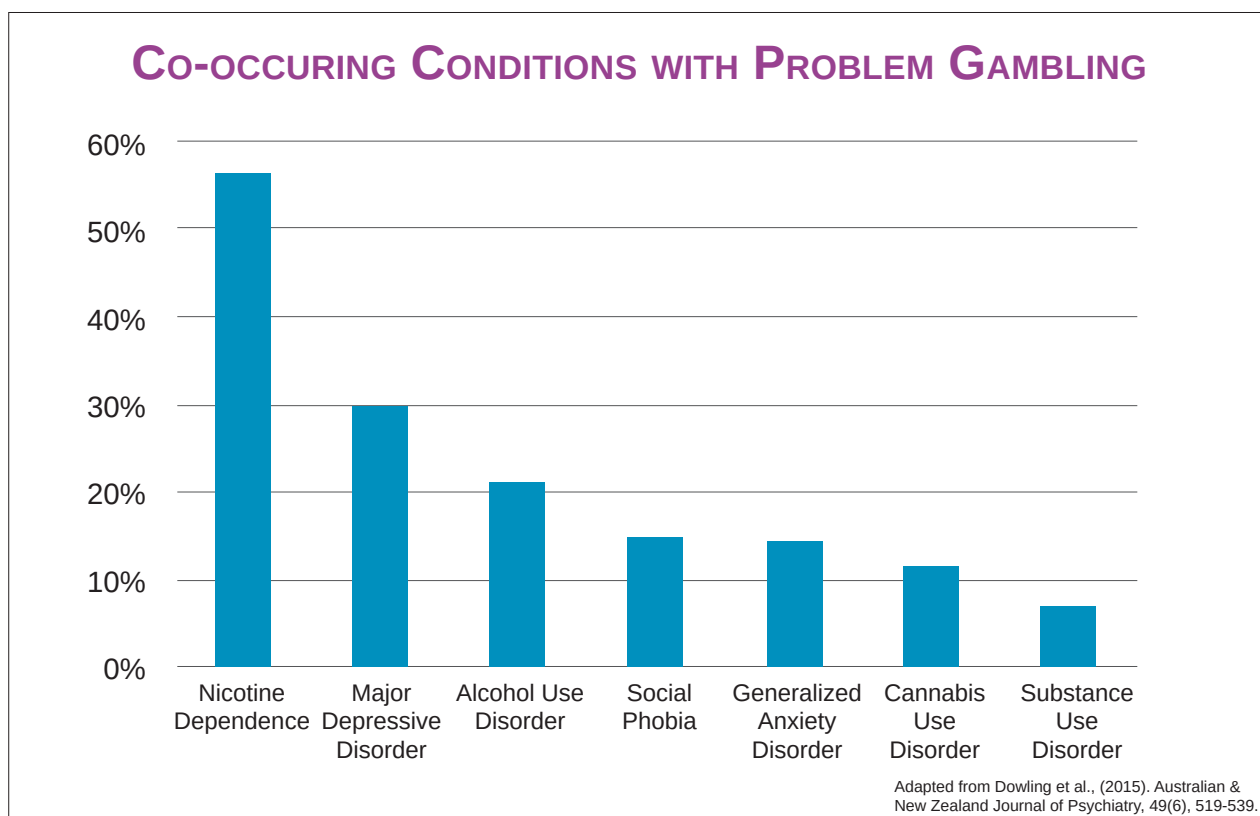


Figure 1

'STOP!' AND 'GO!' NETWORKS RE-VISITED

In another handout in the Brain Connections Series, *How is problem gambling like an addiction to alcohol or drugs from my brain's point of view?*, we saw that people with gambling problems and people with substance use problems show reduced 'GO!' (Reward Hub) network activity. They are less excited by natural rewards compared to unnatural rewards. We also saw similarities in the 'STOP!' network (Top-down Control Network) amongst heavy smokers and people with gambling problems, suggesting that it is hard for these groups to 'put on the brakes' when they need to stop.

How does this affect substitution? Some researchers think that reduced Reward Hub activity could make a person vulnerable to other unhealthy rewards that can hijack this system. You might use unnatural rewards or extreme amounts of natural rewards to push the 'GO!' pedal and increase your feelings of excitement and pleasure, especially at a time when nothing seems to feel good anymore. For example, you might binge repeatedly on your favourite food (a natural reward), or constantly play a video game (an unnatural reward) just to make yourself feel better or as an escape.

At the same time though, reduced activity in the Top-down Control Network can make it harder for you to notice the 'STOP!' signals and put on your brakes (e.g., to hold back from a food binge or to stop gaming when you need to go to sleep). The result could be a new pattern of repeated rewarding behaviour that hijacks your attention and opens the door to another addiction.



NOW VERSUS LATER

Another reason why substitution can happen is that it is hard to wait for a reward. This is because there are differences in how the brain codes immediate and delayed rewards. Individuals with problem gambling, in particular, show differences in how they value rewards and how the brain represents this value¹. When we make choices about rewards, our Reward Hub lights up.

Imagine being asked to choose between getting \$10 now or getting \$100 next week – which option would you pick? Studies show that people with gambling problems are more likely to choose the smaller, but immediate reward over the larger, but delayed reward². They may be less able to wait for the big reward, preferring to choose the reward in the here-and-now, *even though that reward is smaller* in value. Instant gratification wins out over patience for the larger but long-term reward.

¹ Miedl et. al., (2012). *Archives of General Psychiatry*, 69(2), 177-186.

² Amlung et. al., (2016). *Addiction*, 112(1), 51-62.

So, WHY Is It HARD To WAIT For A REWARD?

Choosing a large (but delayed) reward activates the Reward Hub. However, as we already know, this system is compromised in people with gambling problems. Normally, the Reward Hub is in charge of telling us what money is worth. For instance, \$10 might be worth a lot of money to one person but not a lot to another. However, one study discovered that people with problem gambling show a disconnect between what they value (e.g., money) and how the Reward Hub codes that value when presented with a delayed reward option¹. In this study, the Reward Hub in people with problem gambling did not properly show the personal worth of delayed rewards. This may explain why people with gambling problems have difficulty waiting for delayed rewards (such as good health or becoming skilled at a hobby) – they might not even see them as options or worthwhile pursuits. Substituting with small, instant gratifications can feel easier than waiting for long-term rewards.

The good news is that studies are beginning to show that Reward Hub activity can change after a period of abstinence from addictive behaviours. In one study, for example, after 4 months of abstinence, the Reward Hub of substance users began to respond properly to non-drug cues³. In the same way, having a healthy response to non-gambling rewards will help protect you from the dangers of substitution.

ACHIEVING A BALANCED LIFE AND AVOIDING SUBSTITUTION

Part of achieving a balanced lifestyle and avoiding the dangers of substitution means not doing only one thing repeatedly, but having many different ‘branches’ on your ‘tree of life’, to keep things interesting and balanced (see *Figure 2*).

Many of the biggest rewards in life are delayed: they don’t occur right away and they require your investment in order to achieve. Think about the pleasure that comes from a hobby you have worked on for a while, a friendship you have invested in, or a promotion you receive after many hours of work – these are the rewards that last.

Instead of substituting gambling with another ‘quick fix,’ think about how you might start to cultivate a rich, meaningful and deeply rewarding life over the long-term.



Figure 2

ACTIVITY: 'Now' VERSUS 'LATER'?

Circle whether each statement below refers to a 'Now' reward (immediate gratification and small) OR a 'Later' reward (delayed but larger).

- | | |
|---|---|
| 1. Eating a big piece of cake, even though you want to lose 10lbs.
Now or Later | 4. Checking a social media site every 5 minutes to see if somebody replied to your post.
Now or Later |
| 2. Having strong muscles after going to the gym twice per week for 3 months.
Now or Later | 5. Getting a staff recognition award at work
Now or Later |
| 3. Watching your child graduate from college.
Now or Later | 6. Declining an invitation to your best friend's wedding in order to go to your daily exercise class that you never miss
Now or Later |

Answers: 1. Now; 2. Later; 3. Later; 4. Later; 5. Now; 6. Now

GOING FURTHER:

Can you think of a time when you picked a 'Now' over a 'Later' reward? What were the benefits of waiting for the 'Later' reward? How can you apply what you have learned to your current situation?

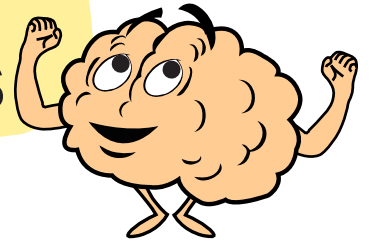
Do you see any substitutions (or potential substitutions) in your life that worry you?

What branches on your 'tree of life' could be strengthened to make your life more rewarding?

TAKE HOME MESSAGE: Sometimes people switch to another addiction when trying to cut back on problem gambling. This is because activity in the Reward Hub and the Top-down Control Network is reduced, which could lead you to pursue unhealthy behaviours and prefer small, immediate rewards over larger, delayed ones. **Be careful with these 'quick fix' rewards that can hijack your attention and cause you to substitute one damaging behaviour with another. The biggest and best rewards often take time but are well worth the effort.**



Take Home Messages

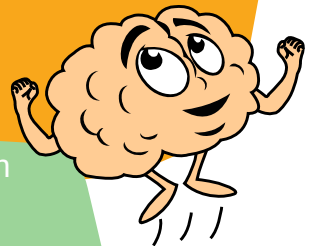


This series answers five questions about problem gambling and the brain that often come up in treatment. Below are the take home messages from each of these handouts. A take home message is a brief summary of the handout's content along with some ideas about changes you can make if you are concerned about your, or a loved one's, gambling. For more information on the five topics, please read the handouts in this series.



Stop and Go Networks: How is problem gambling like an addiction to alcohol or drugs, from my brain's point of view?

When anticipating rewards, the 'GO!' network can show less activity in people with addictions. This means that they might seek out unnatural rewards to activate the 'GO!' network and push the gas pedal to the extreme. This is why people with an addiction may not be as excited by natural rewards and they might also have trouble learning how new experiences could be enjoyable. In addition, people might not notice the need to stop an addictive behaviour and, even if they do, their 'brakes' may not work as well. Nonetheless, the 'GO!' and 'STOP!' networks can change how they respond to natural rewards. **The good news is that the brain is always changing. Keep rewarding yourself with natural, healthy activities in moderation. Repeat these activities because it will take time for your brain to find pleasure again. Avoid unnatural rewards that could wear out your pedal and brakes.**

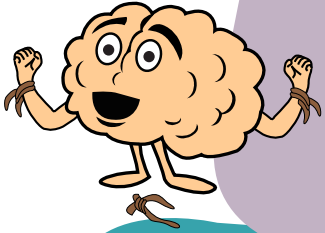


'Liking' vs. 'Wanting': Why do people keep gambling even when it's not fun anymore?

When someone has an addiction problem, there may be a shift in activity from the 'Reward Hub' to the 'Habit Hub'. As the person becomes more addicted, there is a shift from *liking* to *wanting* the reward. A person may want to gamble and not even like it anymore. The brain is also overly aware of the gambling cues which can trigger powerful urges to gamble. But gambling won't feel as fun as it used to because gambling is now a habit and habits don't give us the same pleasure as new experiences. Instead, gambling might have become a way to ease the discomfort of strong urges. **The good news is that our brain learns quickly, so over time we can form new associations to help develop healthy behaviours that we find pleasurable.**

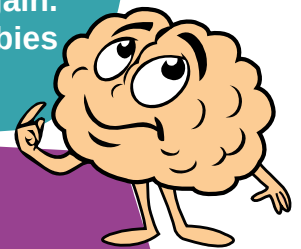
Urges: Why is it hard to say 'no' to a gambling urge?

Saying 'no' to an urge is not always easy. This is because of changes in the brain that occur once gambling has become a problem or a harmful habit. Many parts of the brain are involved, including: the Striatum (which makes you overly-sensitive to gambling cues), the dACC and the mPFC (involved in attention and 'braking'), and the Insula (signalling 'gut feelings'). This is why an urge can feel like a powerful, full-body experience and why willpower alone (without other strategies in place) may not be enough to stop you from acting on an urge. **The good news is that staying in treatment and abstaining from gambling can lead to fewer urges and less sensitivity to gambling cues. Talk to your counsellor about other strategies that might work best for you.**



Setpoints: When I'm not gambling, why does it feel like nothing else – even activities I used to enjoy – will ever be fun again?

The early stages of recovery from problem gambling are associated with anhedonia, which is the reduced ability to experience pleasure. This is a sensitive time period when an individual may have a very low mood, high gambling urges, and experience little pleasure from natural rewards. **The good news is that the brain can also change again during recovery. You may start to enjoy natural rewards again. These improvements take time so it is important to keep practicing hobbies you enjoyed and trying out new activities.**



Substitution: Why do people sometimes switch from gambling to another addiction?

Sometimes people switch to another addiction when trying to cut back on problem gambling. This is because activity in the Reward Hub and the Top-down Control Network is reduced, which could lead you to pursue unhealthy behaviours and prefer small, immediate rewards over larger, delayed ones.

Be careful with these 'quick fix' rewards that can hijack your attention and cause you to substitute one damaging behaviour with another. The biggest and best rewards often take time but are well worth the effort.

