Key points summary, applied to project, for group meeting:

* Good idea to layer reward ratios. Having one gives player good ‘stopping points’ by having overlapping reward schedules the player always has incentive to continue play.
* Have significant rewards given on level ups (fixed ratio). But as player levels the lul become longer and longer.
* During this lul smaller rewards can take the foreground role and tempt the player to continue – soon, the player will near the next fixed ratio reward by completing smaller rewards and keep playing.
* Variable ratios are also an over aching reward tempt, as this will be a random number. The player has no idea how long these will take to complete, but will be aware that the longer they play the more likely they are to receive a reward. **Opportunity to add in boosts to sell to player to increase chance of reward drop/how fast experience is accrued.** Variable ratios provide the most predictable reward schedule, this consistency avoids an off-putting lul as long as exists with fixed ratio rewards. In general, variable ratio schedules produce the highest overall rates of activity of all the schedules.
* Interval schedules. Provide reward after certain amount of time has passed – could make power-up available to player once every [x] levels or every [x] time has passed. **Opportunity to add in boosts to sell to player to increase chance of reward drop/how fast experience is accrued.** A pause with this ratio alone would persist.
* Variable interval, much like variable ratio, but totally dependent on time rather than repeat actions. The random nature of the ratio given players the incentive to keep going as it ‘might be there this time’.
* Special custom ratios can be added – stages to rewards (kill this, go here, wait until chance of this happens). A ‘Chain ratio’. Players often consider access to the next stage of the chain a reward in itself. Something more significant than usual can be offered as a reward for complete chain completion.
* BEWARE: Inconsistencies and rewards below player expectations:
* Extinction – removing player rewards/extending time or needs of obtaining the reward in the same activity/rewarding the player with worse rewards. Causes frustration in the player, deflation, off-putting.
* Behavioural Contrast – when the quality of the reward is reduced for the same task.
* Avoidance – where players must maintain something to avoid deterioration/negative consequences (eg. UltimaOnline, visit your estate every day else it will shrink/influence decrease).

**Reinforcement Schedules**

Either positive reinforcement or negative reinforcement might be used, depending on the situation. In both cases, the goal of reinforcement is always to strengthen the behaviour and increase the likelihood that it will occur again in the future.

Continuous Reinforcement Schedules

In continuous reinforcement, the desired behaviour is reinforced every single time it occurs.

This schedule is best used during the initial stages of learning in order to create a strong association between the behaviour and the response.

Once the response if firmly attached, continuous reinforcement is usually switched to a partial reinforcement schedule.

Partial Reinforcement Schedules

In partial or intermittent reinforcement, the response is reinforced only part of the time. Learned behaviours are acquired more slowly with partial reinforcement, but the response is more resistant to extinction.

**There are four schedules of partial reinforcement:**

Fixed-Ratio schedule

are those where a response is reinforced only after a specified number of responses. This schedule produces a high, steady rate of responding with only a brief pause after the delivery of the reinforcer. An example of a fixed-ratio schedule would be delivering a food pellet to a rat after it presses a bar five times.

* Results in high, steady responding until the reinforcement is delivered
* Best used when learning a new behavior
* Leads to a brief response pause after reinforcement, but responding quickly resumes

Production Line Work: Workers at a widget factory are paid for every 15 widgets they make. This results in a high production rate and workers tend to take few breaks. It can, however, lead to burnout and lower-quality work.

Collecting Tokens in a Video Game: In many video games, you have to collect so many tokens, object, or points in order to receive some type of reward.

<https://www.verywellmind.com/what-is-a-fixed-ratio-schedule-2795190>

Variable-Ratio schedule

occur when a response is reinforced after an unpredictable number of responses. This schedule creates a high steady rate of responding. Gambling and lottery games are good examples of a reward based on a variable ratio schedule. In a lab setting, this might involve delivering food pellets to a rat after one bar press, again after four bar presses, and a third pellet after two bar presses.

* Leads to a high, steady response rate
* Results in only a brief pause after reinforcement
* Rewards are provided after an unpredictable number of responses

Rewards are provided after an unpredictable number of responses – keeping interest, don’t know how long to play for, can lead to partial completion of other goals/rewards which in turn can drive player to continue.

In operant conditioning, a variable-ratio schedule is a schedule of reinforcement where a response is reinforced after an unpredictable number of responses. This schedule creates a steady, high rate of responding. Gambling and lottery games are good examples of a reward based on a variable ratio schedule.

Schedules of reinforcement play a central role in the operant conditioning process. The frequency with which a behavior is reinforced can help determine how quickly a response is learned as well as how strong the response might be. Each schedule of reinforcement has its own unique set of characteristics.

<https://www.verywellmind.com/what-is-a-variable-ratio-schedule-2796012>

Variable Rewards

* Creates craving – predictable rewards don’t create desire (not necessarily the period or route to the reward but the reward itself – if people knew their facebook feed, would they look).
* Users experience surge of dopamine when anticipating a reward, introducing variability multiplies the effect. This creates a focused state which suppresses the areas of the brain associated with judgement and reason, while activating those associated with wanting and desire.
* Having wanted options mixed with mundane makes the user feel intrigue and desire, the thrill of maybe getting what you want.
* The excitement of anticipating something you might want releases more dopamine making you more focused. Before players know it, they’ve spent an hour chasing the next reward.
* Psychologist B.F.Skinner
* Found that with pigeons’ variable rewards (reward after random amount of interactions) yielded more interactions to obtain reward.
* Variability increases activity in the nucleus accumbens and spikes levels of the neurotransmitter dopamine, driving our hungry search for reward. Experiments involving money and heterosexual human males looking at attractive faces of the opposite sex showed increased dopamine levels in the nucleus accumbens.
* Three variable reward types:
* The tribe: social rewards, our brains have adapted to seek rewards that make us feel accepted, attractive, important and included.
  + On social media the varied stream of (known people’s) posts and validating through likes and comments are sought.
  + On stack overflow and other forums, badges/points are earnt. These are meaningful as they show status and worthiness to others, allowing people to outrank their peers.
  + League of legends: honour points, overwatch: vote for player “performance”. Similar way to stack overflow.
* The hunt: the need to acquire physical objects, such as food and other supplies that aid our survival, is part of our brain’s operating system.
  + Pursuit of prey as early man. Today we pursue money, information. Compelled by same instinct.
  + Variable rewards – where the thrill of the chase is the reward itself. Scrolling through reddit where some posts will be mundane, others relevant. Slot machines, where people throw money away at the slightest chance of the jackpot.
* The self: the rewards of the self are fuelled by “intrinsic motivation” as highlighted by the work of Edward Deci and Richard Ryan. Their self-determination theory espouses that people desire, among other things, to gain a sense of competency. Adding an element of mystery to this goal makes the pursuit more enticing.
  + Personal gratification, completing a puzzle – will cause immense frustration while completing, but the completion is the success, huge pay off.
  + Video games allow players to level-up, master skills, unlocking abilities, fulfil a players desire for competency by showing progress/completions. The constant desire to reach higher level, stronger weapons, better armour, visit new areas, keeps the player motivated to log in.
* Gamification is not a one-size-fits-all. Badges, completion merits must match the user’s intent. If the user’s itch is not scratched by the badges then engagement will be unaffected.
* “but you are free to choose” – reaffirming the individuals freedom to choose inspires a stronger action (more donations etc). “but you are free” disarms our instinctive rejection of being told what to do.
* If the experience does not give the user an itch to scratch, similar will happen.
* Rewards must fit into the narrative of why the product is used and align with the users internal triggers and motivations.
* Social acceptance is something all humans crave – being able to rate user interactions etc.
* Be wary of causing ‘reactance’ (hair trigger response when users feel autonomy is threatened – ability to self-govern). Do not want to force users into making a decision, want users to feel they can do what they want to do.
* Variable rewards are a powerful inducement to repeat actions.

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Fixed-interval schedules

are those where the first response is rewarded only after a specified amount of time has elapsed. This schedule causes high amounts of responding near the end of the interval, but much slower responding immediately after the delivery of the reinforcer. An example of this in a lab setting would be reinforcing a rat with a lab pellet for the first bar press after a 30-second interval has elapsed.

There are a few characteristics of the fixed-interval schedule that make it distinctive. Some of these can be seen as benefits, while some might be considered drawbacks.

* Results is a fairly significant post-reinforcement pause in responding
* Responses tend to increase gradually as the reinforcement time draws closer

The big problem with this type of schedule is that the behaviour tends to occur only right before the reinforcement is delivered.

If a child knows she gets her allowance on Sunday as long as her bedroom is clean, she probably won't clean up her room until Saturday night. The response rate is fairly predictable, but increases as the reinforcement time arrives and then drops off precipitously immediately after reinforcement.

Dental exams also take place on a fixed-interval schedule. People who go in for their regular six-month checkup and cleaning often take extra care to clean their teeth right before the exam, yet may not be as diligent on a day to day basis during the six months prior to the exam.

<https://www.verywellmind.com/what-is-a-fixed-interval-schedule-2795189>

Variable-interval schedules

occur when a response is rewarded after an unpredictable amount of time has passed. This schedule produces a slow, steady rate of response. An example of this would be delivering a food pellet to a ​rat after the first bar press following a one-minute interval, another pellet for the first response following a five-minute interval, and a third food pellet for the first response following a three-minute interval.

**Characteristics of the Variable-Interval Schedule**

* Very resistant to extinction
* The rate of response is moderate but steady
* Very minimal pause after reinforcement is given

**Checking Your Email:** Typically, you check your email at random times throughout the day instead of checking every time a single message is delivered. The thing about email is that in most cases, you never know when you are going to receive a message. Because of this, emails roll in sporadically at completely unpredictable times. When you check and see that you have received a message, it acts as a reinforcer for checking your email.

<https://www.verywellmind.com/variable-interval-schedule-2796011>

### **How Do You Choose a Schedule of Reinforcement?**

Once the behaviour has been learned, switching to a partial schedule is often preferable.

<https://www.verywellmind.com/what-is-a-schedule-of-reinforcement-2794864>

<https://www.learning-theories.com/game-reward-systems.html>

<http://www.gamasutra.com/view/feature/131494/behavioral_game_design.php>

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