

Schedules of Reinforcement

"The schedule of reinforcement for a particular behaviour specifies whether every response is followed by reinforcement or whether only some responses are followed by reinforcement"

What is a Schedule of Reinforcement?

A schedule of reinforcement is a protocol or set of rules that a teacher will follow when delivering reinforcers (e.g. tokens when using a token economy). The "rules" might state that reinforcement is given after every correct response to a question; or for every 2 correct responses; or for every 100 correct responses; or when a certain amount of time has elapsed.

Broadly speaking there are two categories of reinforcement schedule, the first being a "continuous" schedule and the other being an "intermittent" schedule.

A continuous schedule of reinforcement (sometimes abbreviated into CRF) occurs when reinforcement is delivered after every single target behaviour whereas an intermittent schedule of reinforcement (INT) means reinforcement is delivered after **some** behaviours or responses but never after each one.

Continuous reinforcement schedules are more often used when teaching new behaviours, while intermittent reinforcement schedules are used when maintaining previously learned behaviours (Cooper et al. 2007).

Continuous Schedule of Reinforcement (CRF)

Within an educational setting, a CRF would mean that the teacher would deliver reinforcement after every correct response from their student/s. For example, if you were teaching a student to read the letters A, B, C, and D, then everytime you presented one of these letters to your student and they correctly read the letter then you would deliver reinforcement.

For an everyday example, every time you press the number 9 button on your television remote control your TV changes to channel 9; or every time you turn on your kettle it heats up the water inside it; or every time you turn on your kitchen tap (faucet) water flows out of it (unless any of these are broken of course).

Continuous Schedule of Reinforcement (CRF)			
Trial	Teacher	→ Child	→ Consequence
1	Asks a question	Answers correctly	Reinforcement delivered
2	Asks a question	Answers correctly	Reinforcement delivered
3	Asks a question	Answers correctly	Reinforcement delivered
4	Asks a question	Answers correctly	Reinforcement delivered
5	Asks a question	Answers correctly	Reinforcement delivered
6	Asks a question	Answers correctly	Reinforcement delivered
7	Asks a question	Answers correctly	Reinforcement delivered
8	Asks a question	Answers correctly	Reinforcement delivered

A continuous schedule of reinforcement.

Intermittent Schedules of Reinforcement

There are four basic types of intermittent schedules of reinforcement and these are:

- Fixed-Ratio (FR) Schedule.
- Fixed Interval (FI) Schedule.
- Variable-Ratio (VR) schedule.
- Variable-Interval (VI) schedule.

Fixed-Ratio Schedule (FR)

A fixed-ratio schedule of reinforcement means that reinforcement should be delivered after a constant or “fixed” number of correct responses. For example, a fixed ratio schedule of 2 means reinforcement is delivered after every 2 correct responses. The chosen number could be 5, 10, 20 or it could be 100 or more; there is no limit but the number must be defined.

Generally, when writing out a fixed-ratio schedule into the discrete trial script it is shortened into just “FR” with the number of required correct responses stated after it (Malott & Trojan-Suarez, 2006). For example, choosing to reinforce for every second correct response would be written as “FR2”; reinforcing for every fifth correct response would be an “FR5”; for every 100 correct responses would be an “FR100” and so on.

Note that when running an ABA programme, you may see the reinforcement schedule defined as “FR1”. Technically this is a continuous reinforcement schedule (CRF) but to keep in line with how other ratio schedules are defined it is written using the “FR” abbreviation and so is written as “FR1”.

An "FR1" Fixed-Ratio Schedule of Reinforcement

Trial	Teacher	→ Child	→ Consequence
1	Asks a question	Answers correctly	Reinforcement delivered
2	Asks a question	Answers correctly	Reinforcement delivered
3	Asks a question	Answers correctly	Reinforcement delivered
4	Asks a question	Answers correctly	Reinforcement delivered
5	Asks a question	Answers correctly	Reinforcement delivered
6	Asks a question	Answers correctly	Reinforcement delivered
7	Asks a question	Answers correctly	Reinforcement delivered
8	Asks a question	Answers correctly	Reinforcement delivered

An "FR2" Fixed-Ratio Schedule of Reinforcement

Trial	Teacher	→ Child	→ Consequence
1	Asks a question	Answers correctly	No Reinforcement
2	Asks a question	Answers correctly	Reinforcement delivered
3	Asks a question	Answers correctly	No Reinforcement
4	Asks a question	Answers correctly	Reinforcement delivered
5	Asks a question	Answers correctly	No Reinforcement
6	Asks a question	Answers correctly	Reinforcement delivered
7	Asks a question	Answers correctly	No Reinforcement
8	Asks a question	Answers correctly	Reinforcement delivered

Comparing an FR1 and an FR2 schedule of reinforcement.

Variable-Ratio Schedule (VR)

When using a variable-ratio (VR) schedule of reinforcement the delivery of reinforcement will "vary" but must **average out** at a specific number. Just like a fixed-ratio schedule, a variable-ratio schedule can be any number but must be defined.

For example, a teacher following a "VR2" schedule of reinforcement might give reinforcement after 1 correct response, then after 3 more correct responses, then 2 more, then 1 more and finally after 3 more correct responses.

Overall there were a total of 10 correct responses ($1 + 3 + 2 + 1 + 3 = 10$), reinforcement was delivered 5 times and so reinforcement was delivered for every 2 correct responses **on average** ($10 \div 5 = 2$). As can be seen in the image below, reinforcement did not follow a constant or fixed number of correct responses and instead **“varied”** and hence the name “variable-ratio” schedule of reinforcement.

“VR2” Variable-Ratio Schedule of Reinforcement			
Trial	Teacher	Child	Consequence
1	Asks a question	Answers correctly	Reinforcement delivered
2	Asks a question	Answers correctly	No Reinforcement
3	Asks a question	Answers correctly	No Reinforcement
4	Asks a question	Answers correctly	Reinforcement delivered
5	Asks a question	Answers correctly	No Reinforcement
6	Asks a question	Answers correctly	Reinforcement delivered
7	Asks a question	Answers correctly	Reinforcement delivered
8	Asks a question	Answers correctly	No Reinforcement
9	Asks a question	Answers correctly	No Reinforcement
10	Asks a question	Answers correctly	Reinforcement delivered

Total Correct	Total Reinforcement	Average
10	5	2

A variable ratio schedule of reinforcement. Specifically a VR3 schedule.

Fixed-Interval Schedule (FI)

A fixed-interval schedule means that reinforcement becomes available after a specific period of time. The schedule is abbreviated into “FI” followed by the amount of time that must pass before reinforcement becomes available, e.g. an FI2 would mean reinforcement becomes available after 2 minutes has passed; an FI20 means 20 minutes must pass and so on.

A common misunderstanding is that reinforcement is automatically delivered at the end of this interval but this is not the case. Reinforcement only becomes available to be delivered and would only be given if the target behaviour is emitted at some stage after the time interval has ended.

To better explain this say a target behaviour is for a child to sit upright at his desk and an FI2 schedule of reinforcement is chosen. If the child sits upright during the 2 minute fixed-interval no reinforcement would be given because reinforcement for the target behaviour is not available during the fixed-interval.

If the child is slumped in his seat after the 2 minute interval elapses reinforcement would still not be given because reinforcement is only now available to be given. Just because he emitted the target behaviour (sitting upright) during the interval does not mean reinforcement is delivered at the end of the interval.

Say 10 more minutes pass before the boy sits upright, it is only now that he has emitted the target behaviour and the interval is over that reinforcement would be delivered. Once reinforcement is delivered then the 2 minute fixed-interval would be started again. After the 2 minute fixed-interval had elapsed, it could have taken 2 seconds, 10 minutes, 20 minutes, 200 minutes or more until the boy sat upright, but no matter how long it would have taken, no reinforcement would be delivered until he did.

Variable-Interval Schedule (VI)

The variable-interval (VI) schedule of reinforcement means the time periods that must pass before reinforcement becomes available will “vary” but must average out at a specific time interval. Again the time interval can be any number but must be defined.

Following a “VI3” schedule of reinforcement, a teacher could make reinforcement available after 2 minutes, then 5 minutes, then 3 minutes, then 4 minutes and finally 1 minute. In this example, reinforcement became available 5 times over a total interval period of 15 minutes. On average then, three minutes had to pass before reinforcement became available ($2 + 5 + 3 + 4 + 1 = 15 \div 5 = 3$) and so this was a VI3 schedule.

Just like a fixed-interval (FI) schedule, reinforcement is only available to be delivered after the time interval has ended. Reinforcement is not delivered straight after the interval ends, the child must emit the target behaviour after the time interval has ended for the reinforcement to be delivered.

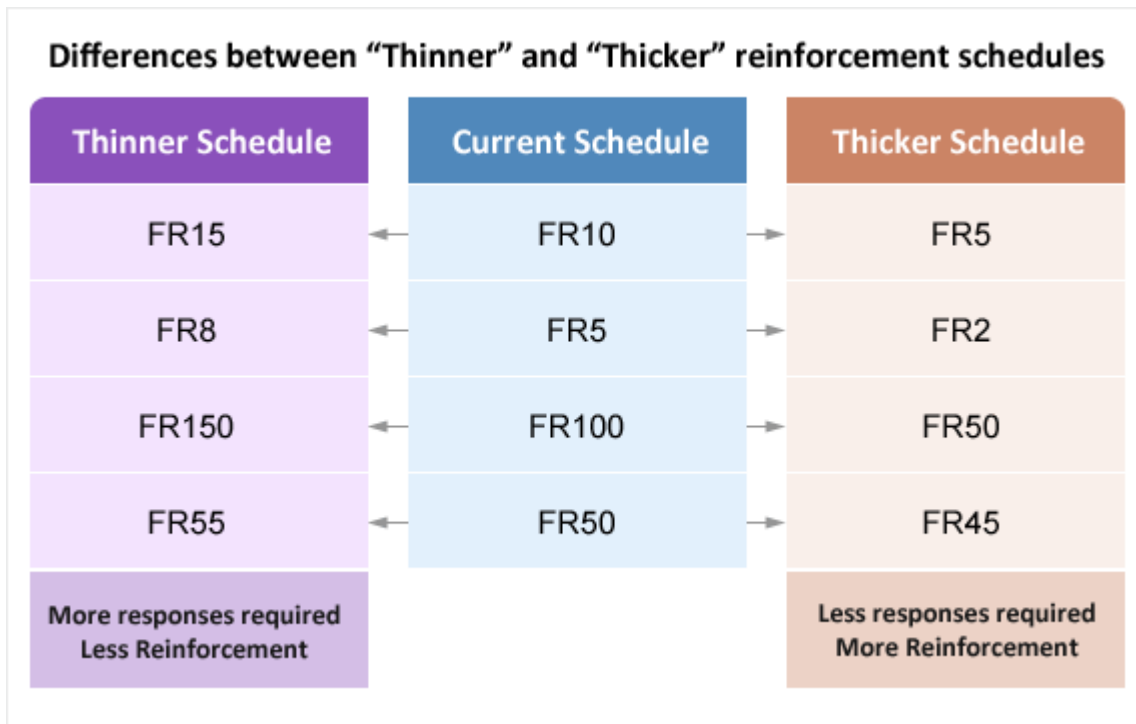
Thinner and Thicker Schedules of Reinforcement

Sometimes you might hear the term “thicker schedule of reinforcement” or “thinner schedule of reinforcement”. These terms are used to describe a change that may be made to a schedule of reinforcement already being used.

For example, if a teaching programme was using an FR10 schedule (reinforcement delivered after every 10 correct responses), then a “thinner” schedule would mean increasing the amount of correct responses needed to earn reinforcement so the amount of reinforcement is reduced or “thinned”. Think of “thinner” in terms of “less” reinforcement. So for example, a thinner schedule than an FR10 schedule might be an FR15 schedule, so the child would now have to get 15 correct responses before earning reinforcement.

A “thicker” schedule would mean decreasing the amount of correct responses needed to earn reinforcement so the amount of reinforcement is increased. Think of “thicker” in terms of

“more” reinforcement. So a thicker schedule than an FR10 might be an FR5 schedule, so the child would now have to get only 5 correct responses before earning reinforcement. Sometimes the term “denser” schedule of reinforcement might be used to denote a thicker schedule – but these terms mean the same thing.



Thinner and thicker schedules of reinforcement.

Combining Schedules of Reinforcement

Say a teacher is working through a spelling programme with a child and is using a token economy as positive reinforcement on an FR2 schedule of reinforcement; one token (reinforcement) is being delivered for every second correct spelling. So for the first trial, the teacher says “Spell apple”, the child correctly spells the word and the teacher does not give a token...but what does the teacher do? How does the child know if he’s right or wrong?

To combat this, combinations of reinforcement schedules may be used where “verbal praise” is on a continuous (or an FR1) schedule of reinforcement while the token economy is on the FR2 schedule.

So for every correct spelling, the teacher would say something like “great job!” or “brilliant!” or “you’re right!” and then every second correct spelling is reinforced with a token as well as verbal praise. In these cases, you would likely see “FR1 praise, FR2 token” written out in the discrete trial script to specify which schedules of reinforcement are being used.

“FR1 Praise” and “FR2 Token” Compound Schedule of Reinforcement

Trial	Teacher	→ Child	→ FR1 Praise	FR2 Token
1	Asks a question	Answers correctly	Reinforcement	No Reinforcement
2	Asks a question	Answers correctly	Reinforcement	Reinforcement
3	Asks a question	Answers correctly	Reinforcement	No Reinforcement
4	Asks a question	Answers correctly	Reinforcement	Reinforcement
5	Asks a question	Answers correctly	Reinforcement	No Reinforcement
6	Asks a question	Answers correctly	Reinforcement	Reinforcement
7	Asks a question	Answers correctly	Reinforcement	No Reinforcement
8	Asks a question	Answers correctly	Reinforcement	Reinforcement

Combining fixed ratio schedules of reinforcement to deliver both tokens and verbal praise for correct responding.