

THE IN A HURRY SERIES

Habits *in a Hurry*

Tiny changes, big compounding wins

Max Brocklesby

BOOKSINAHURRY.COM

Contents

The Whole Thing in One Page 4

Why You Should Care 5

The Core Ideas 7

How It Actually Works 20

What People Get Wrong 29

Use It 34

Terms 39

Go Deeper 42

Notes and Sources 44

Bibliography 52

The Whole Thing in One Page

A habit is usually pictured as a small ritual tied to a reward: cue, routine, prize, repeat. Do it for twenty-one days, protect the streak, become the kind of person who does it, and the result will compound. The picture is tidy, marketable and misleading wherever precision matters.

A habit is a stored answer to a recurring situation. You enter the kitchen after work and reach for the same cupboard. You sit on a train and your thumb opens the same app. You finish brushing your teeth and reach for the floss. The situation has become able to call up a response before you make a fresh decision. You may still stop it. You may still choose something else. The habit is the learned push, not an order.

Repetition builds this link when enough of the situation recurs for the response to become familiar there. The calendar alone teaches nothing. A daily alarm can ring for months without turning the action it requests into a habit; the action has to happen. There is no universal graduation day. Twenty-one days came from a surgeon's observations about adjustment to a changed self-image, not a habit experiment. Sixty-six days came from one much-quoted health-behaviour study and is no more a deadline than the average shoe size is a prescription.

Consequences matter because rewarding, relieving or useful actions are more likely to be repeated. They do not have to appear as a separate treat after every performance. Dopamine is involved in learning and motivation, but it is not a chemical switch marked habit. Once a cue-response association is strong, the cue can prompt the action even when the outcome has lost some appeal. That is why habits save effort and why they can outlive their usefulness.

Whole routines rarely become mindless blocks. The start may become habitual while the work remains deliberate. Putting on running shoes can require no debate; choosing a route, adjusting pace and crossing a road still demand judgement. A habit can therefore carry a complex activity to its starting line without carrying it through every metre.

Goals still matter. They select what to practise, supply reasons to persist and can override an unwanted impulse. Plans help translate intention into repetition. Yet the environment often decides whether a plan gets enough chances to become a habit. Visibility, access, time, social rules and a few seconds of friction can matter more than a stirring promise made on Sunday night.

Breaking a habit is not deleting a file. Old associations can fall quiet and return in an old setting. Avoidance, added friction, inhibition, context change and an alternative response can each help, depending on the problem. One lapse therefore reveals a condition under which the old answer still wins. It does not erase every repetition that came before it.

Then the compounding. Repeated actions can accumulate useful results; earlier gains can also make later efforts more productive. Neither process guarantees exponential improvement. Benefits can level off, and the same repetition can deepen an unwanted pattern. Yesterday's response helps design tomorrow's situation through the surroundings, skills and expectations it leaves behind. The question is what that next situation will make easier.

That is the book.

Why You Should Care

Change the position of one app on your phone and watch your thumb expose you. Your thumb may still reach for the old square, sometimes before you remember what you meant to open. Nothing dramatic has happened. The screen still looks familiar. Yet the error reveals a part of your behaviour that normally stays hidden: the movement began from a learnt arrangement, not from a fresh instruction issued in words.

The same thing happens when you reach for a light switch in a room that has been rewired, take the old turn after moving house, or find yourself standing beside the biscuit cupboard while still composing a reason not to eat one. These moments feel faintly absurd because the person explaining

the action arrives after the action has started. We prefer a cleaner picture of ourselves as a sequence of decisions. Much of daily life is organised so that decisions do not have to be made again.

That economy is indispensable. Imagine choosing from first principles how to tie a lace, make tea, greet a colleague, reverse a car, begin a familiar spreadsheet or find the bathroom at night. Deliberation is slow and attention is scarce. Learnt responses let familiar situations take over the opening move while thought is used elsewhere. A good habit is therefore more than repeated virtue. It is a piece of behaviour whose control has been partly transferred to the world around you.

That transfer explains why knowledge so often fails. You can know that walking would help, that the phone can wait and that tomorrow's work would improve if you began now. Knowledge has to compete with a response that is already cued, available and cheap. The contest is unfair if one option is on the desk, logged in and glowing while the other requires shoes, weather, time and a route. Calling the result weak character describes the loser and ignores how the race was set up.

It also explains why good intentions sometimes work for a fortnight and then disappear. The first phase of change is carried by reasons, novelty, reminders and effort. The hoped-for later phase is different: the situation itself begins to help. The book beside the chair prompts a few pages. Closing the laptop prompts tomorrow's list. Entering the station prompts the stairs. The person still has reasons, but no longer needs to reconstruct them at every encounter.

There is no guarantee. Some behaviours are too rare, variable or difficult to become strongly cue-responsive. Some contexts refuse to stay stable. A parent with a sick child, a nurse on rotating shifts, a tenant sharing one crowded room and a worker whose schedule changes each week do not possess the same raw material for routine. Habit advice that ignores control over time and place turns unequal opportunity into a morality play.

Nor are all automatic tendencies welcome. A response can remain efficient

after it has become expensive. The shortcut through email can interrupt every hard task. The nightly purchase can survive the budget it once fitted. A familiar route can carry someone towards a drink, a bet or an argument before the later consequences enter view. Clinical addiction, compulsive behaviour and mental illness require more than a general habit manual, but the overlap matters: repeated situations can acquire power, and removing blame does not remove the need to change them.

The useful promise is narrower and stronger. Once you can see behaviour as an arrangement among cues, learnt responses, goals, consequences and opportunity, failure becomes more informative. You can ask which situation called the action, what made repetition possible, where deliberation returned, and whether the environment keeps voting against the plan. Those questions do not make change effortless. They make it less mysterious, less moralised and more open to design.

The Core Ideas

A Habit Is a Stored Answer

Opening a messaging app may be habitual when a notification appears, deliberate when you need an address, and accidental when you tap the wrong icon. The visible action is identical. What changes is how it was controlled.

A habit belongs to the link between a situation and a response, not to the response by itself. In the habitual case, some feature of the situation has acquired the ability to bring the action to mind and prepare it before its current merits are fully considered. Watching the tap tells you what happened. It does not, by itself, tell you why.

That feature is a cue. A cue can be a place, a time, an object, another action, a person or an internal state. Finishing dinner may cue washing up. Anxiety may cue checking. A particular chair may cue reading, while the same book remains unopened elsewhere. Cues rarely announce themselves. Their power is learnt from reliable co-occurrence, so the person

often notices the action more readily than the condition that called it.

This gives a more precise meaning to automaticity. Automatic does not mean unconscious, effortless, fast and impossible to stop all at once. Those qualities can separate. You may notice the urge immediately, need effort to carry out the response, and remain able to inhibit it. A strong habit can create a rapid impulse without forcing the body to obey. Treating every learnt tendency as compulsion exaggerates habit and blurs the boundary with addiction and other clinical problems.

Frequency is not enough either. A weekly board meeting can be repeated for years and remain heavily planned. A rare response can be strongly cue-bound if the cue itself is rare, such as fastening a seat belt upon entering a car. Routine is broader still. It describes a regular sequence from the outside, whether each part is habitual, deliberate, required by rules or prompted by another person. Calling something a routine tells you what recurs. Calling it a habit should tell you why part of it starts.

The distinction matters because behaviour change depends on the controller. If an action is deliberate, reasons, information and incentives may shift it. If it is cued, the person can sincerely change their mind while the old situation continues to prepare the old response. A warning on the biscuit packet reaches judgement. The open packet on the desk has already reached the hand.

This also explains why habits feel like character. The same person meets the same cues, produces the same responses and then describes the pattern as who they are. Sometimes the description is useful. It can organise goals and make consistency meaningful. It is still a description laid over a learnt system. Move the person into another setting and the supposedly fixed trait may weaken; restore the old setting and it may return.

Habit becomes easiest to see when it misfires. You walk towards the old office after your company has moved, type a former password into the new system or put the empty milk bottle where the bin used to be. The response is sensible for a world that recently existed. Psychologists call such errors

action slips. They show that the problem is not ignorance: you know the address, password or bin has changed. The old cue-response relation starts first, especially when attention is occupied. A slip is therefore a small experiment performed by ordinary life. It separates what you currently believe from what the familiar situation has learnt to prepare.

A habit, then, is neither a moral achievement nor a defect hidden in the personality. It is a stored answer that a recurring situation has learnt how to request. The first practical question is therefore not, "Why am I like this?" It is, "What keeps asking?"

Repetition Changes Control

A new action begins as a small problem. You have to remember it, decide whether now is the time, arrange what is needed and perform it while the old response remains easier. Repetition changes that burden. When the same response follows a sufficiently similar cue, the cue becomes a better predictor of what comes next. The action is prepared more readily, and less fresh construction is required.

At first you may rehearse an instruction while making tea: put the washing on afterwards. Later, carrying the empty mug towards the sink may bring the washing to mind. You can still decide against it. What has changed is that the situation supplies part of the reminder. The action has acquired help that was missing when it depended on remembering an intention at an arbitrary moment.

Learning the new answer does not require forgetting the old one first. Imagine deciding that your keys belong on a hook rather than in their usual bowl. Knowing the rule is immediate; reaching for the hook may not be. You can understand the plan perfectly and still need to interrupt the old movement. If the hook is hidden behind a coat, the plan has made its own reminder hard to encounter. Uncovering it gives the intended response a fairer chance to be practised.

Ease need not arrive all at once. You might stop forgetting the action before you stop debating it, or begin readily while the performance still feels

awkward. These are different changes. Formation studies find large differences in reported automaticity, not a universal timetable. Waiting to feel entirely effortless can hide progress in the part that used to fail.

A clock time can work where the day is predictable; an existing routine can work where the hour varies but the sequence remains. A randomised nutrition study found no clear winner between those cue types. Breakfast has no special authority over 8.00 a.m. What matters is repeated, feasible encounters with the intended action.

When the cue occurs, a missed performance is a missed learning opportunity. Yet one omission need not erase the learning. In Lally and colleagues' formation study, a single missed opportunity did not materially damage the fitted process. That is different from saying repetition is optional. A gap is small because it is one gap. A pattern of gaps is a different training history.

This is where tiny changes earn their place. A small action is not magically powerful because it is small. It is useful when smallness removes enough cost for the action to occur under ordinary conditions. Two minutes of language practice cannot produce fluent speech by itself. It can make opening the lesson, entering the study context and beginning less dependent on a heroic mood. Once the start is reliable, the dose can grow while the cue remains stable.

The danger is confusing the gateway with the destination. One press-up can preserve a starting ritual on a bad day, but a permanent programme of one press-up will not deliver the adaptations expected from training. Reading one sentence can keep contact with a book, but it does not make 300 pages disappear. Smallness supports repetition; the repeated behaviour still has to be large or progressive enough to produce the intended result.

Formation is therefore a matching problem. The cue must recur. The response must be feasible. The reward or usefulness must support another attempt. The context must be similar enough to teach a prediction without becoming so narrow that the behaviour fails everywhere else. Repetition

does not remove control. It moves part of control from a fresh decision into a learnt relationship with the world.

Consequences Teach, Cues Call

An action has two temporal neighbours: what comes before it and what follows. Popular habit diagrams often label these cue and reward, then place a routine between them. That sequence is memorable, but it tempts the reader to imagine three visible boxes that must appear on every occasion. Learning is less theatrical.

Consequences help select behaviour. If an action produces food, relief, approval, progress, pleasure or the removal of irritation, repeating it becomes more likely. The outcome need not be grand. Closing a rattling window is reinforced by the immediate silence. Checking a message is reinforced unpredictably by novelty or social contact. Preparing tomorrow's coffee may be satisfying because morning friction falls. The consequence can be external, internal or delayed, though immediate and reliable feedback is easier to learn from.

As learning develops, the predictive work shifts. At first, the outcome may be the main reason to act. With repetition, features that precede the action acquire significance because they predict the response and its consequences. The cue can then call up the response before the outcome is consciously represented. This is why someone may open an app and only then realise there was nothing they wanted to see.

Dopamine belongs inside this story, but not in the role assigned to it online. In influential recordings from some midbrain dopamine neurons, bursts and pauses reflected differences between expected and received rewards. An unexpected reward produced a signal; as prediction improved, much of the response shifted towards the cue; an omitted expected reward produced a dip. This reward prediction error helps learning update. It is not a measure of moral weakness, a reservoir that can be drained, or a stamp placed on every habit.

Nor does pleasure alone explain persistence. Some habits are repeated

because they remove discomfort. Some remain after enjoyment has faded. Some useful actions never become deeply automatic despite clear long-term benefits because the benefit arrives too late and the immediate performance remains costly. The outcome that matters for learning is the one the system can connect to the response, not the one a spreadsheet proves will matter in thirty years.

Adding a separate treat can support early repetition, but it leaves a question for later: what happens when the treat stops? Someone walking to earn cake may keep walking while the bargain appeals, without finding the walk itself any more attractive. That is not proof that rewards fail. It means the reward and the developing habit have different jobs. Choosing a tolerable activity, making progress visible or sharing it with someone enjoyable may help too. A useful habit need not be entertainment; it need not be needlessly punishing either.

Bad habits exploit the same asymmetry. Their immediate consequence is often reliable while the cost is delayed and distributed. Checking the feed supplies novelty now; the unfinished work remains for later. The purchase delivers anticipation now; the budget absorbs it at month end. The avoidance response removes anxiety for a moment and thereby teaches itself, even when the postponed task becomes more threatening. The nervous system is not making a lifetime calculation. It is learning what changed after the response.

Consequences teach which actions are worth repeating. Cues later retrieve what was learnt. Confusing the two leads to weak advice: reward yourself forever, chase dopamine, or assume that removing pleasure removes the habit. Better questions are available. What consequence supported the early repetitions? What cue now prepares the response? Has the outcome changed while the cue-response link remains? Each answer names a different lever.

Complex Routines Are Coalitions

Making coffee looks like one habit until the grinder jams. Then the apparent unit separates into recognising the mug, filling the kettle, measuring beans, adjusting to missing milk and deciding whether the result is acceptable. Familiarity has reduced the need to deliberate over many steps, but judgement has not vanished. A routine can be highly practised without becoming one indivisible reflex.

The cleanest distinction is between instigation and execution. Instigation is getting started. Execution is carrying the activity through. The cue for leaving work may trigger a trip to the gym with little debate. The session still requires choices about equipment, load, pain, other users and time. The beginning can be habitual while the performance remains guided by goals, feedback and skill.

In one study of 123 adults, the habitual strength of exercise instigation predicted exercise frequency more clearly than habitual execution did. The result does not make every workout the same, and it comes from one health-behaviour setting. It does expose why “make exercise a habit” is too coarse. What many people need to automate is the transition into exercise: packing the bag, going to the place, changing clothes or beginning the warm-up. The useful unit is often the doorway rather than the entire session.

Repeated sequences can also be chunked. A skilled typist does not select each letter as an isolated movement. A driver does not verbally order every adjustment through a familiar junction. Smaller actions become organised into larger units, reducing the number of decisions needed. Yet chunks can be opened when conditions change. Roadworks, a new keyboard or pain in one hand brings control back into finer detail.

That flexibility matters because complex behaviour contains variable parts. Cooking dinner involves a recurring time and place, familiar tools and common opening moves, but ingredients, quantities and other people differ. A surgeon may have routines for preparation and checking while every operation still demands attention. A writer may begin at the same desk with

the same document sequence and remain unable to automate the sentence worth writing.

Calling the whole activity a habit can hide where failure occurs. Someone may reliably arrive at a desk and then avoid the difficult file. Another may produce good work once started but fail to begin. A third may begin and continue yet stop whenever an interruption appears. These are different control problems. The cue, the opening action, the working sequence and the recovery after disruption may each have their own learning history.

It also explains why extending a small habit is not automatic. A cue that reliably prompts two minutes of stretching has learnt to prompt two minutes of stretching. Increasing the duration changes the response and often its cost. The old association helps with initiation, but the new execution still has to be trained. A gateway habit can carry a person across the threshold. It cannot promise what happens after entry.

Do not ask whether reading, exercise, writing or healthy eating has become a habit as though the answer must cover the whole category. Ask which part starts from a cue, where judgement returns and where the sequence breaks. Naming the failing part is more useful than declaring the whole person inconsistent.

Goals Choose the Direction

Habits are often advertised as an escape from motivation. That is half right in the way that causes trouble. A strong cue-response link can reduce how often motivation must win. It cannot decide which response should be learnt, arrange the early repetitions or judge whether the result remains worth having.

Most useful habits begin inside goal pursuit. You decide to practise a language, protect focused work or call a parent. The goal gives the action a reason and helps it survive while the cue-response link is weak. Repetition then lowers the cost of initiation. The relationship is cooperative: deliberate control establishes a path, and habit can make returning to it less expensive.

Goals also remain capable of veto. A familiar route may prepare a turn, yet a closed road changes the choice. The phone may invite checking, yet an urgent conversation can hold attention elsewhere. Habit research describes a tendency that competes and combines with current intentions. It does not show a small automatic creature taking permanent command of the body.

Plans are useful because goals are too abstract to meet a Tuesday.

“Exercise more” specifies a desired direction while leaving time, place and opening action unresolved. An implementation intention gives the goal an address: when a named situation occurs, perform a named response.

Across many studies, these if-then plans have improved goal attainment on average. They help people notice an opportunity and translate intention into action. They are not proof that the action has become habitual; the plan may continue doing active work.

Monitoring can perform a related job. A tick, log or visible count makes repetition and drift easier to see. It can also become the wrong target. A person who protects a streak by recording a token performance may preserve the number while abandoning the outcome. The measure should answer a useful question: did the relevant response occur in the planned context, and is the intended result moving? A chain of green squares is evidence only if the squares represent something worth repeating.

Identity sits one level above the mechanism. Saying “I am a runner” can support choices, make inconsistency uncomfortable and connect a practice to social belonging. Repeated behaviour can also produce the identity after the fact. Studies find a substantial association between habit and identity in health behaviour, but much of the evidence is correlational. It cannot establish that adopting a sentence about the self causes the cue-response association to form.

Identity becomes dangerous when it turns data into judgement. Missing a run means a planned response did not occur under particular conditions. It need not mean the person has been exposed as an impostor. Conversely, a proud identity can protect an obsolete routine from evidence. The person who sees himself as someone who never misses may train through injury or

keep a business process that no longer works.

Goals choose the direction, plans create encounters, and habits can make one response easier to retrieve. Each has a different job. Trying to replace all three with motivation produces repeated decisions. Trying to replace all three with habit produces efficient movement without review. The aim is not to stop choosing forever. It is to choose where thought adds value and let learnt structure carry the rest.

The Environment Often Casts the Deciding Vote

Put a bowl of fruit on a clear table and biscuits in an opaque box on a high shelf. Nothing inside the person has been rewritten. The available sequence has changed. One response is visible and immediate; the other requires remembering, opening and reaching. Those seconds are small enough to sound ridiculous and large enough to alter which repetitions occur.

Friction is the effort, delay, uncertainty or social awkwardness between a cue and a response. Removing it can help a desired action: shoes by the door, a notebook beside the breakfast bowl, a document already open, ingredients ready. Adding it can interrupt an unwanted one: logging out, moving the charger, leaving the card at home, separating the trigger from the response. Friction does not abolish desire. It changes whether desire receives an easy route to action.

The environment also supplies cues. A stable setting can become a compact memory system because objects and preceding actions remind the person without words. This is why relocation can weaken familiar patterns. In studies of students who moved, behaviours such as exercise, newspaper reading and television viewing transferred more reliably when relevant context features remained stable. A new place did not wipe every association. It changed which old cues were present and which responses still fitted.

Context is wider than a room. It includes time, other people, preceding actions, mood, bodily state and rules. A habit formed after a calm breakfast may fail on school-run mornings. A person who never smokes alone may

respond strongly with one group of friends. Fatigue can narrow the set of responses that remain feasible. The environment is partly physical and partly social, and much of it is not owned by the individual.

That last fact limits the self-help version of habit design. Behaviour requires capability and opportunity as well as motivation. A rotating shift removes a dependable time cue. Unsafe streets change the cost of walking. Chronic pain changes the action. Care work breaks sequences that look trivial on paper. Poverty makes bulk preparation, equipment, storage and spare time unevenly available. No arrangement of sticky notes creates resources that are absent.

Institutions can shape repeated behaviour through shared architecture. Software defaults, door placement, meeting schedules, payment systems and workplace norms decide which action is one click away and which requires an exception. A form that remembers the previous choice can save effort or preserve an error. A company that schedules every discussion for an hour makes an hour the available unit. A manager can test that arrangement without pretending that one hour was ever the natural length of a conversation.

Opportunity can therefore dominate intention without disproving intention. The person may care deeply and still lack enough stable encounters to train the response. Conversely, someone with a well-arranged setting can look disciplined because the desired action is repeatedly the easiest available answer. Character may differ, but the environment has been allowed to take credit in one case and escape blame in the other.

Goals may lead you to redesign the setting; the redesigned setting then reduces how often the goal must intervene. That is why environment and will are not opposing explanations. One can help the other. Good design does not remove agency. It stops wasting it on avoidable obstacles.

Compounding Builds the Next Context

The subtitle promises big compounding wins, and the phrase needs rescuing from its own arithmetic. Raise 1.01 to the power of 365 and the answer is about 37.8. Raise 0.99 to the same power and the answer is about 0.0255. The calculation is correct. It assumes that every day delivers the same proportional change, that each change multiplies the whole previous result, and that no ceiling, injury, interruption or interaction alters the rate. Human behaviour rarely signs that contract.

Small actions can create large effects without obeying that curve. Ten pages a day adds pages: accumulation. Practice that makes later practice more productive changes the return on the next effort: a possible compounding effect. Keeping an already tidy filing system in order is maintenance. All three can be worthwhile. Calling every repeated benefit compounding makes them sound alike while hiding what the action needs to achieve. A growing pile, a growing capability and the prevention of a growing mess are different successes.

A delayed payoff is different again. Weeks of language practice may seem unrewarding until enough words make a conversation possible. That is a threshold: separate pieces have become sufficient for a new task. It becomes a feedback loop if conversation then supplies practice, corrections and reasons to continue. The threshold explains why earlier effort mattered despite little visible return. The feedback explains how gains might support further gains. Neither requires a fixed daily percentage.

Benefits often saturate. The first regular walk may change a sedentary week more than the thousandth changes an active one. A filing routine can remove growing disorder until the system is under control, after which each repetition maintains rather than multiplies. A tiny action may also sit below the dose needed to move the outcome. Consistency cannot rescue an intervention that is harmlessly irrelevant.

Systems interact. Imagine that a regular end-of-day tidy leaves the tools ready for tomorrow. Starting then costs less effort, and finishing becomes

more likely. By contrast, repeatedly leaving a workspace in disorder makes each return begin with clearing it. Neither effect requires a mysterious multiplier. One action has changed the cost of another. The connection matters: improving one isolated routine can disappoint when the next task remains blocked.

This returns to the stored answer. A repetition can do more than strengthen an association. It can reshape the situation in which the next response occurs. The person who prepares equipment creates a visible cue. The person who practises gains competence, so the same task costs less. Colleagues begin to expect a meeting note. A shelf fills with finished work. The response changes the context, and the changed context increasingly asks for the response.

That loop creates lock-in as well as progress. A nightly purchase changes recommendations, saved payment details and expectations. Avoidance preserves the threatening task and adds consequences, making the next encounter worse. Repeated lateness changes trust and can make social repair harder. A system can compound friction against the person while the person appears to be repeating one small act.

Efficiency, though, is not permanence. A response can run easily in its familiar setting and falter when that setting disappears. Habit therefore needs conditions that keep making the useful action possible, not a promise that effort has been abolished. Gains also need somewhere to remain: in finished work, improved capability or less future repair. Review matters because a response fitted to an old context can stay efficient after the goal changes. The loop deserves to survive only while it still helps.

The strongest habit is not the one that never needs thought again. It is the one embedded in a system that produces the intended result, tolerates interruption and remains open to correction. Tiny changes matter because they can begin that system at a cost ordinary life can bear. Big wins arrive when repetition makes future useful action more likely and when the consequences are allowed to remain. The same mechanism can build a staircase or deepen a rut. Habit supplies the return. Judgement still chooses

what the returns are for.

How It Actually Works

The cat in the box

A hungry cat is shut in a wooden box, with food outside. In Edward Thorndike's experiments, boxes had different escape mechanisms, including loops to pull and levers to press. The cats scratched and pushed at the enclosure until a movement released the door. Escape did not become faster on every attempt. Across repeated trials, however, unsuccessful movements tended to decline and the effective response arrived sooner. The useful action was being selected from a disorderly beginning.

Thorndike reported the puzzle-box experiments in 1898. What impressed him was the absence of a theatrical flash of insight. The cats did not appear to inspect the mechanism, infer the rule and step calmly out. Their improvement was gradual. Responses followed by a satisfying consequence were more likely to recur; responses that achieved nothing faded. Thorndike called this the law of effect.

The box exposed a durable idea. Behaviour can become organised by its consequences without a little thinker first explaining the rule. With repetition, the setting can bring the effective movement forward. Food and escape supplied a powerful motive; the animal did not also need to understand a theory of learning.

One trial could be slower than the previous one while the overall path still improved. Learning appeared in the pattern across attempts, not a ceremonial successful day. Ordinary variation was compatible with change.

James and the grooves of conduct

Eight years before Thorndike's monograph, William James had devoted a chapter of *The Principles of Psychology* to habit. His physiology belonged to the nineteenth century, but his psychological observation was sharp: repetition makes conduct easier to start and less demanding to continue, while stable order lets one action cue the next.

James understood habit as a property of a plastic nervous system and a practical fact of social life. People become able to perform skilled sequences without inspecting every movement. Institutions also depend on repeated conduct. The clerk, soldier, craft worker and pianist can act reliably because training has reduced the need for moment-by-moment invention.

His advice was stern. Launch a new practice decisively, allow no exception while it is taking shape, and seize the first chance to act on a resolution. Some of that survives. Early repetition matters, and an intention that never meets behaviour teaches little. Other parts now need correction. One lapse does not return learning to zero. Maximum effort is not the only route to stability. The person whose plan is too expensive to repeat may be training failure with impressive commitment.

James also treated habit as social infrastructure. A society could function because people arrived, dressed, queued, worked and observed conventions without reopening every rule. That insight cuts both ways. Repeated order frees thought, but it can preserve institutions after their reasons have weakened. A custom may feel natural because its alternatives have stopped presenting themselves, not because the custom survived a fair comparison each morning.

His social argument is less comfortable. James praised habit for keeping the miner at work and protecting the fortunate from uprisings among the poor. He treated settled patterns as a defence of social order, not as evidence that the order was fair. That distinction matters beyond his century. A routine can make a workplace dependable and keep an unfair division of work intact. Ease is not an ethical verdict. The same mechanism that saves

someone effort can help an institution avoid a question it ought to answer.

Behaviour without a little manager

The twentieth century turned that observation into an experimental programme. Behaviourists distrusted explanations that placed an invisible intention behind every visible act. They changed food, cues, timing and consequences, then measured what animals did. The laboratory became a controlled economy of levers, keys, mazes and rewards.

B. F. Skinner's operant chambers made the relation between response and consequence unusually clean. A rat pressed a lever, a pigeon pecked a key, and the schedule of reinforcement altered the resulting pattern. Reward after every response produced one pattern; intermittent and changing schedules produced others. The work showed that the timing and reliability of consequences could organise behaviour without requiring the animal to narrate its reasons.

Operant learning also differed from the conditioning made famous by Ivan Pavlov. A sound paired with food could come to produce salivation, a response elicited by a predictive cue. In an operant chamber, the animal's action changed what happened next. The distinction matters because habits concern learnt action as well as learnt anticipation. A notification may raise expectation; tapping it is a response with its own history.

Shaping showed how a behaviour absent at the start could be built by reinforcing closer approximations. A pigeon need not peck the key spontaneously on command. Movements towards the key could be selected until the target response emerged. Modern advice about making a start smaller inherits part of this logic, though a human plan includes language, goals and understanding that the chamber was designed to exclude.

This tradition gave psychology a powerful language of reinforcement, extinction, stimulus control and shaping. It also encouraged an overreach. If behaviour can be predicted from past consequences and present stimuli, the current value of the goal can disappear from the explanation. The organism begins to look like a record of its training history, emitting

whatever response the setting has paid for before.

Everyday experience resists that picture. You can take a familiar route because it leads home, then choose another when the road closes. You may stop ordering a favourite meal after learning an ingredient has changed. A response can be practised and still depend on what its outcome is worth now. The hard question became how to tell action guided by an expected result from action released by a familiar cue.

The hungry rat changes its mind

Outcome devaluation supplied an answer. Train an animal to perform an action for food. Then reduce the value of that food, perhaps by feeding it to satiety or pairing it with illness. Test the action without delivering the food. If responding falls, the animal appears to represent the relation between action and outcome and to care about the outcome's current value. If responding continues, control appears to have shifted towards a stimulus-response association that can run with less regard for what the action now produces.

Anthony Dickinson's work in the 1980s helped organise this distinction between actions and habits. Under some laboratory conditions, limited training left behaviour sensitive to devaluation while extensive training made it less so. A response could begin as a means to an outcome and acquire a degree of autonomy through repetition.

The result gave habit a stricter scientific meaning than “something done often”. It also produced one of the field's most memorable models: two forms of control operating over the same movement. One system asks, in effect, which action currently leads to the valued result. The other retrieves the response associated with the present situation. Neither needs to be conscious in the ordinary sense, and both can contribute at once.

Researchers could vary another relation as well: whether the action still caused the outcome. If food arrived regardless of a lever press, a goal-directed animal should reduce a now-pointless action. Sensitivity to this contingency offered a companion test to devaluation. Together, the methods

asked two separate questions. Does the animal still care about the result, and does it still represent the action as the cause?

The model explains a familiar error. You may know the supermarket has moved an item and still turn into the old aisle. Knowledge updated faster than the context-response link. It also explains useful efficiency. A skilled sequence need not recalculate every consequence at every step. Control can be economical until the world changes. What begins as intelligence can become autonomy, and what looks like mindlessness may once have been a sensible response to a stable world.

The test has a trap: first check that the food or other outcome has lost its appeal. Otherwise an animal or person still seeking it can look habitual merely by continuing. A 2026 human study demonstrated this problem, finding that apparent habit-like responding clustered among participants for whom devaluation had worked poorly. Continued action is informative only when the supposedly changed reason to act has changed too.

Nor must every change be gradual. In a 2026 experiment, some male mice shifted abruptly towards stimulus-driven responding after they had already learnt a water-and-tone task. Knowing the task and changing its control were separate events. This does not supply a sudden-switch timetable for people learning to floss. It shows why getting better at an action and becoming less dependent on evaluating its outcome should not be treated as the same change.

Two controllers, one action

Neuroscience mapped parts of this distinction onto loops linking the cortex and basal ganglia. In rodents, goal-directed and more habitual control have often been associated with different striatal regions. A small human imaging literature, including a 2009 study, has also implicated posterior putamen and related circuitry as behaviour becomes extensively practised. These findings matter. They do not reveal a habit button.

The basal ganglia contribute to action selection, learning, movement and motivation across many tasks. Dopamine changes learning through

prediction errors and other signals, but a chemical involved in updating value is not identical to habit. Complex behaviour recruits sensory systems, motor plans, memory, attention and current goals. The nervous system does not separate cleanly into a rational office upstairs and an automatic basement pressing buttons below.

A familiar cue makes one response available quickly. Evaluation may support it, modify it or stop it. Time pressure and distraction can reduce the chance to correct that first response before acting. This is competition and cooperation, not a switch that automatically turns stressed people into creatures of habit. The practical difference is visible in a wrong turn caught before the junction versus the same turn noticed after it: an impulse can be present in both, although only one produces an error.

Practice can free attention for higher-order choices, as when a driver handles the car while thinking about the route. The same economy can produce a slip when the familiar sequence wins in a changed setting. Expertise therefore contains a productive paradox. The performer gains flexibility because lower-level control is efficient, yet efficiency creates places where an obsolete answer can run ahead of current knowledge.

This mixed control is especially clear in skilled routines. The pianist's fingers draw on learnt sequences while the musician adjusts timing. The nurse follows a checking routine while responding to an unusual patient. The reader turns pages automatically and interprets sentences deliberately. Asking whether the whole activity is habitual forces a binary answer onto a layered process.

Habit leaves the laboratory

Outside the laboratory, the action worth explaining might be a journey to work, a snack or the start of an evening's television. Researchers began asking people about what they were doing while daily life was still happening, rather than inviting them to describe their usual selves afterwards.

In two diary studies published in 2002, university students reported their

behaviour, thoughts and feelings across the day. Around two-fifths of sampled actions were frequently repeated in stable contexts, the studies' way of identifying habitual behaviour. During such actions, thoughts were more likely to be elsewhere. That is recognisable: the hands can be occupied with a familiar task while the mind is occupied with an entirely different problem.

A later study asked 105 adults in the United Kingdom and Australia about behaviour six times daily for a week. It separated starting an activity habitually from carrying it out habitually, and asked about intention too. All were common. Habit and intention were not opposites competing for slices of one pie: someone could want an action that also came readily from the situation. Its percentages cannot be read as a historical increase over the earlier study, which asked different questions of different people.

A move offered another way to see the link. Wendy Wood, Leona Tam and Melissa Guerrero Witt followed students through a move to university. Familiar behaviours transferred more reliably when important features of their former contexts remained. The same person carried intentions across the move; the cues did not always travel. The finding helped establish habit discontinuity, the opportunity created when a life change weakens old context-response links before new ones settle.

Then researchers watched people try to create habits on purpose. Phillippa Lally and colleagues asked 96 volunteers to select a daily health-related behaviour and repeat it in a chosen context for twelve weeks. Automaticity rose gradually, with wide individual differences and no universal finish line. Among 39 cases with a good-fitting curve, estimates for reaching near-maximum automaticity ran from 18 to 254 days, and some long estimates extended beyond the observation window. The famous average concealed the main result. People, actions and contexts differed.

A later randomised trial assigned 192 adults to connect a nutrition behaviour either to a daily routine or to a clock time. Neither cue type proved superior. Repeated performance mattered more than allegiance to one cue philosophy. A plan tied to breakfast still needs breakfast to happen, and a

plan tied to 8.00 a.m. still needs the person to be free then. Naming a cue is the beginning of an arrangement, not evidence that the arrangement works.

A 2024 review found 20 health-behaviour studies involving 2,601 participants, but only four reported formation time. Their differing estimates and measures cannot supply one universal deadline. A calendar advances even when the planned action never occurs.

That leaves a question a person can investigate without a laboratory: where does the intended sequence break? There is no need to diagnose a hidden brain state before checking whether the cue appeared, the action was possible and the result was worth returning for. Those observations will not certify a habit. They can tell you what to change next.

The book beside the chair

Imagine trying to read in the evening instead of drifting into your phone. This is a worked example, not a reported case or a promised sequence of results. The first plan is to read more. It has excellent intentions and no appointment. By the time you sit down, the phone is in your hand and the book is somewhere on a shelf. The old response has arrived equipped. The new one has arrived as an opinion.

Give the intention an appointment: after putting the evening mug on the side table, open the book that is already beside the chair. Choose a small amount you would welcome reading, rather than a quota designed to impress your future biographer. Charge the phone elsewhere. These changes do different jobs. The mug names the occasion, the nearby book reduces the search, and the charging point makes the alternative less immediate. None installs a habit. Together they make a useful repetition easier to arrange.

Suppose the plan still fails. On some evenings the mug lands on the table, but you fetch the phone before touching the book. The cue was present; the competing action won. On other evenings dinner runs late and there is no tea. The intended occasion never happened. A record of two missed reading sessions would make those evenings look identical. They call for

different repairs. One concerns the response to a cue that appeared. The other concerns choosing an occasion you can expect to encounter.

Suppose instead that opening the book becomes easy, but you stop reading almost immediately. That need not be a failure of habit formation. Perhaps the book demands more attention than you have left, or perhaps you do not like it. The start and the activity have parted company. Moving the cue earlier may address tiredness; choosing a different book may address taste. Adding a more elaborate tracking system addresses neither. A routine deserves adjustment when it delivers the wrong experience with admirable consistency.

Then take the arrangement away. On a visit to someone else's house, there may be no familiar chair or evening mug. You can still read deliberately; you have not lost the ability or the reason. What is missing is some of the help that made starting easy at home. A portable book and a chosen occasion can support the visit without proving that the old association has followed you. Returning home may restore the prompt. Context dependence is a reason to plan for travel, not a verdict on your character.

Over time, the useful question changes again. Opening the book matters because it lets reading happen, not because opening books is an achievement in its own right. More finished pages accumulate. Greater familiarity with the subject may make later pages easier to understand. Enjoying the book may make returning more attractive. Those are possible payoffs to inspect, not benefits bestowed by the streak counter. The arrangement has succeeded when it supports reading you value, including the freedom to put down a book that no longer earns your attention.

How we know

Habit is inferred, not observed directly. Animal experiments can test what happens when a learnt action no longer produces a valued outcome. Human laboratory tasks bring that test closer to us, but can misclassify action if the attempt to change the outcome's value fails. Neither directly tells us how a person builds an evening routine. Theories also differ over how independently habits operate from goals; this book uses the context-response account while treating goal-directed and habitual influences as capable of working together.

Field studies follow ordinary behaviour but often rely on volunteers' reports of how automatic it feels. They are concentrated in health behaviours, with uneven representation of other populations and settings. Frequency, ease, reported automaticity and insensitivity to an outcome are related questions, not interchangeable measurements. A study of motivated adults drinking water cannot establish a timetable for every working or caring routine.

The practical examples extend the mechanisms, not the samples. They illustrate ways to inspect a cue, a response and the conditions of repetition. They do not establish one best intervention or guarantee that a useful action will become effortless.

What People Get Wrong

“A habit takes twenty-one days”

The number did not come from a controlled habit study. In *Psycho-Cybernetics*, published in 1960, the plastic surgeon Maxwell Maltz wrote that people needed about twenty-one days to adjust to an altered appearance or changed circumstance. He presented roughly three weeks as a minimum period for changing a mental image. The subject was adaptation and self-image. Repetition of a cue-bound behaviour was not measured.

The later evidence refuses one deadline. One formation study produced

estimates spanning under three weeks to more than eight months among 39 good-fitting individual curves. A 2024 review found reported individual estimates from 4 to 335 days across a small set of health-behaviour studies. Behavioural complexity, cue frequency, reward, context stability and the person all matter.

The number survived because a finish line is easier to sell than a curve. It turns change into a short challenge, makes a missed day look legible and promises that effort will soon end. None of those commercial advantages makes it a biological constant.

The correction changes the task. Day twenty-two is neither graduation nor failure. Ask whether the behaviour is recurring in the intended context and becoming easier to initiate. Time passes by itself. Associations do not.

“Every habit is a cue-routine-reward loop”

The loop is a useful teaching sketch and a poor universal anatomy. A cue can prompt a response, and consequences can support repetition. That does not mean every performance contains three separate stages that the person can identify. Reward may have helped select the response earlier and need not appear as a treat afterwards. A complex routine may contain several cues and mixtures of automatic and deliberate control.

The diagram also hides a crucial distinction. What comes before an action helps retrieve it; what follows helps teach whether it should recur. Once learning is established, removing one visible reward may leave the cue-response association intact. Conversely, adding chocolate after flossing does not ensure that the bathroom context will later prompt flossing.

The loop became persuasive because it turns an invisible learning history into a picture anyone can remember. The cost of that clarity appears when people hunt for a reward that was never a separate event or assume that changing the reward must remove the response.

Use the loop as a prompt for questions, not as a machine that guarantees an answer. Which cue is present? Which response was learnt? Which

consequence supported repetition? They may not fit into one neat circuit.

“Willpower is the main lever”

Some plans make willpower work overtime by requiring the same resistance again and again. A phone within reach, an open packet, a logged-in shop and an undefined intention create a series of contests. Winning some says little about whether the contest was well designed.

People with useful habits may appear unusually disciplined because they encounter fewer moments requiring inhibition. They have arranged tools, routes, defaults and social expectations so the preferred response is available. Self-control can be spent upstream: removing the cue, adding friction, choosing a stable time or making the first action clear.

The willpower story remains attractive because success can be claimed as virtue and failure assigned to the individual. It requires no examination of workload, access, product design or the number of temptations a setting produces. A theory that explains everything through effort is unusually convenient for anyone who built the setting.

This does not make personal choice irrelevant. Somebody must often create the arrangement and refuse the unwanted response while the new one is weak. It changes where effort is best used. Character is an expensive control system. Good architecture lets it supervise exceptions rather than operate every movement.

“One missed day sends you back to zero”

A streak is a record, not a nervous system. In Lally and colleagues' twelve-week study, one missed opportunity did not materially alter the fitted habit-formation curve. The old pairings remained part of the learning history.

That finding does not prove that omissions never matter. Several missed encounters reduce practice and may allow another response to occupy the cue. A lapse can also lower confidence and trigger the familiar thought that a failed perfect plan is no plan at all. The damage often comes from the interpretation and what follows, not from one unperformed action deleting

previous learning.

Streaks help when they make repetition visible and provide immediate satisfaction. They harm when the number becomes so sacred that one break licenses abandonment or token performances replace useful ones. The calendar is a feedback device, not a court record.

Treat the lapse as an observation. Was the cue absent, the response too costly, the context unusual or the alternative more rewarding? Repair the system at that point. The useful recovery rule is neither protect every streak nor forgive everything. Resume at the next relevant opportunity and learn why the previous one failed.

“A bad habit must always be replaced”

Substitution is sensible when a frequent cue will keep calling for some response. Reaching for a book instead of a phone, walking after dinner instead of opening an app, or preparing a neutral reply instead of beginning the familiar argument gives the situation another answer to learn.

It is not the only method. In a 2026 trial, 313 adults with an unwanted snacking habit received substitution, inhibition, reduced-access instructions, versions with an added in-app reward, or a control condition. Self-reported automaticity fell across groups, with a faster first-week decline in the intervention groups. The study did not detect one generally superior strategy or a clear added reward effect. It does not prove the methods equivalent: adherence was uneven and the outcome was self-reported snacking automaticity. A move, new job or changed schedule may also weaken an old pattern without a direct substitute.

Replacement advice can also move the problem sideways. Substituting endless low-calorie snacks for one eating pattern may preserve constant cue-driven eating. Replacing one feed with another can keep the checking sequence intact. The alternative must change the relevant response, not merely improve its branding.

The old association may remain capable of returning, especially in its

original context. That is an argument for planning, not for a replacement ritual in every case. Match the method to the cue, the cost of exposure and whether the situation itself can be changed.

“Dopamine is the habit chemical”

Dopamine is involved in learning, motivation and movement across several brain systems. In reward-learning experiments, dopamine activity can signal the difference between what was expected and what occurred. As predictions improve, responses can shift towards the cue. That is richer than the internet's pleasure molecule and narrower than a master explanation for routine.

Habits draw on distributed networks connecting cortex and basal ganglia. Some form around relief rather than pleasure. Some persist after enjoyment falls. Some strongly rewarded actions never become stable habits because the context keeps changing. A dopamine spike is neither a diagnosis nor a practical unit that can be reset by avoiding music, screens or breakfast.

The slogan also invites unnecessary remedies. People speak of dopamine detoxes as though normal signalling were a contaminant and ordinary enjoyment a damaged receptor. Reducing an overpowering cue may help for behavioural reasons. The useful intervention does not require a fictional chemical cleanse.

Neural language should improve the behavioural model. When it replaces cue, response, outcome and context with one fashionable molecule, it has made the explanation worse.

“One per cent better compounds automatically”

The famous calculation is mathematically sound: 1.01 multiplied by itself 365 times is about 37.8. It is not evidence that a person becomes nearly thirty-eight times better in a year. The equation assumes an identical proportional gain every day, full retention of each gain and no ceiling or interruption.

Some outcomes do accumulate. Pages are written, money is saved,

strength can increase and relationships can be maintained. Their rates differ. Gains may saturate, decay, interact or require a minimum dose. Repeating one minute of poor practice can entrench error. A daily purchase can add to debt that may itself grow through interest.

Additive progress can still be impressive. Five pounds saved each day does not need exponential growth to become £1,825 across a year. Thirty minutes of practice need not improve performance by the same percentage each time to create more than 180 hours of contact. Honest arithmetic is strong enough.

The useful claim survives without fake precision. Tiny actions can make repetition affordable, and repeated useful action can change future capacity and context. Before invoking compounding, ask how an earlier gain changes the return on a later effort. Otherwise a finance metaphor has been mistaken for a law of behaviour.

Use It

Choose an action a camera could see

“Be healthier”, “read more” and “stop procrastinating” are goals or verdicts. They do not specify the response that a situation can learn to prompt. A habit plan needs an observable action: put the notebook beside the plate, open the document, read two pages, place the phone in the drawer, begin the warm-up.

The camera test is useful because it removes hidden negotiation. Could a silent recording show whether the action occurred? “Work on the business” fails. “At 9.00, open the supplier list and call the first uncontacted company” passes. The action can still be badly chosen, but at least success and failure now refer to behaviour rather than mood.

Choose the smallest unit that controls the real bottleneck. If starting is unreliable and execution is strong, build the opening move. If arrival is easy and continuation fails, shrinking the start will not solve the relevant problem.

Name the point where the sequence currently breaks.

Give it a cue you will meet

A cue is useful only if it occurs, can be recognised and arrives when the response is possible. “After breakfast” may be excellent for someone who eats breakfast in one place and useless for someone whose mornings change daily. A clock time can be dependable at work and fragile during weekends.

Prefer a cue already embedded in life: after placing the mug in the sink, when the laptop reaches the desk, upon returning from lunch. The cue should come immediately before the response where possible. A reminder delivered two hours before the opportunity creates a memory task rather than a clean pairing.

Attaching one action to a reliable preceding action is often called habit stacking. Its value comes from the existing action acting as a cue, not from the slogan. A stack of six new behaviours creates six opportunities for failure and may collapse when the first routine changes. Establish one useful link, check that the response is feasible at that moment, then add complexity only when the sequence earns it.

Test specificity. “In the evening” contains many settings. “After I put my dinner plate in the dishwasher” names an event. Avoid a cue so narrow that the habit cannot travel. If reading occurs only in one airport lounge, the association may be strong and mostly useless.

Make the first repetition cheap

During formation, the response competes with forgetting, uncertainty and whatever was done before. Lowering its initial cost increases the chance that the cue and response will meet often enough to learn one another. Prepare equipment, reduce setup and choose a version that remains feasible on an ordinary day.

Cheap does not mean meaningless. The opening action should point towards the intended practice. One sentence can begin a writing session;

reorganising the pen drawer probably cannot. A five-minute walk can establish leaving the building; buying a new watch is not a smaller form of walking.

Decide in advance how the response may grow. The minimum protects continuity when conditions are poor. The normal dose should still serve the outcome. A plan that celebrates one press-up forever has solved adherence by abandoning training. Tiny is a bridge across initial resistance, not a permanent exemption from sufficient work.

Move friction before the decision

List the steps between cue and action. Shoes in a cupboard, a dead battery, a forgotten password and an empty kitchen are each small alone. Together they can make the intended response lose before deliberation begins. Remove steps from useful behaviour and add them to behaviour you want time to reconsider.

For a desired action, make tools visible, ready and near the place of use. Preselect the document, route or first exercise. For an unwanted action, log out, remove stored payment, move the object, silence the cue or require a second device. The aim is not to create an impenetrable wall. A pause of ten seconds may be enough for the current goal to arrive before the learnt response finishes.

Review social friction too. A practice that requires apologising, negotiating space or appearing strange is not low-cost because its equipment is ready. Ask who controls the room, schedule, food, software or money. Some friction can be moved only by agreement or institutional change.

Treat a lapse as a diagnosis

Do not begin with the story that you failed because commitment vanished. Reconstruct the encounter. Did the cue occur? Was it noticed? Was the response available? Did another response start first? Had the context changed? Was the planned action too large for that day?

Then match the repair. If the cue was absent, choose a more dependable

one. If materials were missing, prepare them earlier. If an interruption broke execution, create a return cue. If the old response remained easier, add friction or rehearse an alternative. If the action no longer serves the goal, stop protecting it merely because it once counted as consistency.

Resume at the next relevant opportunity rather than promising to compensate. Doubling tomorrow's effort can turn an omission into punishment and make another miss more likely. Recovery can have its own cue: when a planned repetition is missed, return to the normal action at the next planned encounter.

Ask whether the problem is a habit

A person cannot habit-design a skill they do not possess, a resource they cannot access or a decision that changes every time. Before changing cues, ask whether capability, opportunity or motivation is missing.

Capability problems need learning, assistance, treatment or a simpler task. Opportunity problems may require time, money, safety, equipment, permission or another person's cooperation. Motivation problems may concern the goal itself, an unattractive consequence or a conflict with something valued more. Habit methods help when repeated contexts and responses are central. They become a distraction when the binding constraint sits elsewhere.

Use this test on organisations as well. Repeated late reports may reflect an awkward workflow, unclear ownership or data that arrives late. Calling the problem a staff habit protects the process from inspection. A hospital, school or business creates recurring situations at scale. Redesigning one shared system can change more behaviour than asking every person for greater discipline.

The limits

Habit design cannot make all valuable behaviour automatic. Novel work, moral judgement, diagnosis, strategy and care often require attention precisely because the situation differs. The goal is not a life in which thought has been removed. It is to stop spending thought on stable openings and repeated maintenance when it could be used on what changed.

These are methods to test, not instructions guaranteed by a timetable. The direct formation evidence is strongest for selected health behaviours; using the same ideas in a volatile job or demanding creative work calls for checking what happens, not assuming transfer.

Some repeated behaviour belongs to addiction, obsessive-compulsive disorder, eating disorders, trauma responses or other clinical conditions. General methods such as changing cues and friction may support treatment, but they do not replace assessment or care. Risk, withdrawal and severe impairment require the specialist level.

And control over context is unequal. Advice to prepare meals, walk outside, protect mornings or remove devices assumes space, time, safety and authority that many people do not have. A theory of habit should reveal those constraints, not repackage them as excuses.

The one thing to keep

Keep the stored answer.

When behaviour repeats, stop looking first for a permanent virtue or flaw inside the person. Look for the situation that has learnt how to request the response. Ask how often the cue appears, what action it prepares, which consequence trained it, what friction shapes it and whether the person has the opportunity to answer differently.

That model changes success too. The disciplined person may have built a world that remembers on their behalf. The struggling person may be meeting a setting that presents the old answer quickly and the desired one at a cost. Neither conclusion removes agency. It locates agency where it

can work: in selecting goals, arranging encounters, practising responses, recovering after lapses and changing systems that keep producing the wrong request.

Tiny changes matter when they alter that request. Put the book where the hand lands. Make the opening move clear. Remove one step from the useful response and add one before the harmful one. Repeat until the setting begins to help. Then inspect the result, because efficiency can preserve a mistake as faithfully as a good decision.

A habit is the past reaching into the present through a familiar cue. Once you can see that reach, you can decide what deserves to become the next stored answer, and what should no longer be asked of you at all.

Terms

Habit. A learnt tendency for a recurring cue or context to prompt a response with reduced need for fresh deliberation. The tendency influences action but does not make the response compulsory.

Habitual behaviour. Behaviour performed under substantial habit control. The same visible action can be habitual on one occasion and deliberate on another, so repetition alone does not settle the classification.

Automaticity. The degree to which a process begins quickly, efficiently, with limited awareness or limited intention. These features can separate, which is why automatic does not mean unconscious and unstoppable.

Cue. A feature present before behaviour that can retrieve or prepare a learnt response. Cues include places, objects, times, preceding actions, people, moods and bodily states.

Context. The configuration in which behaviour occurs, including physical surroundings, social company, time and internal state. Habit depends on recurring features rather than on place alone.

Context-response association. The learnt link through which encountering a context increases the accessibility or readiness of a response. It is the

central mechanism in many contemporary definitions of habit.

Repetition. Repeated performance of a response, especially in relation to a recurring cue. Repetition supplies learning opportunities, but variable contexts or inconsistent responses can weaken what is learnt.

Habit strength. The estimated power of a cue-response association, often inferred from automaticity reports, context-linked performance or experimental tests. It is not identical to frequency or personal commitment.

Reinforcement. A consequence that increases the later probability of behaviour under relevant conditions. Reinforcement describes an observed learning relation, not merely a prize deliberately offered after a task.

Reward. An outcome treated as valuable or capable of supporting learning. Pleasure, relief, progress and social response can function as rewards, while delayed benefits may guide goals without strongly reinforcing repetition.

Reward prediction error. The difference between an expected and obtained outcome. Dopamine activity can encode such errors in important settings, allowing predictions and behaviour to update when events surprise the learner.

Goal-directed action. Behaviour selected partly through knowledge of what an action produces and the current value of that outcome. It can coexist and compete with cue-responsive habitual control.

Action-outcome association. A learnt representation that a particular action causes or predicts a result. Sensitivity to changed outcomes or changed action consequences is evidence of goal-directed control.

Outcome devaluation. An experimental method that reduces the value of an expected outcome, then tests whether the action falls. Continued responding may suggest habit, but ineffective devaluation can produce false classifications.

Action slip. A familiar response performed when current knowledge or

intention supports another action, such as taking an old route. Slips reveal cue-based preparation because the person often knows better.

Instigation. The initiation of an activity, including transitions such as leaving for the gym or opening a document. Instigation may become habitual even when the activity itself remains effortful and deliberate.

Execution. Carrying an activity through after it starts. Execution can contain automatic motor sequences, skilled monitoring, decisions and responses to change, especially in complex routines.

Routine. A recurring sequence or schedule viewed from the outside. A routine may combine habits, rules, goals, reminders and social requirements, so it should not be treated as one automatic unit.

Action chunking. The organisation of smaller responses into a larger learnt unit, reducing the number of separate selections required. Chunks support skill but can reopen when conditions or feedback change.

Friction. Effort, time, delay, uncertainty or social cost between a cue and a response. Small changes in friction alter which behaviours receive enough repetitions to become easy and familiar.

Prompt. An external signal intended to remind or direct action. A prompt can create an opportunity for repetition, though dependence on a reminder does not by itself prove a habit has formed.

Implementation intention. An if-then plan linking a specified situation to a specified response. It helps translate goals into action and may support formation, while remaining distinct from the learnt habit itself.

Context stability. Recurrence of the features that cue and permit behaviour. Stability makes prediction easier, though a habit tied too narrowly to one setting may fail to transfer elsewhere.

Habit discontinuity. Weakening or interruption of familiar cue-response patterns after a context change, such as moving home or changing work. Discontinuity can create an opportunity for deliberate redesign.

Inhibition. Stopping a prepared or initiated response. Inhibition can prevent habitual behaviour without erasing the underlying association, so continued exposure may require repeated control or environmental support.

Extinction. A reduction in a learnt response when the outcome that previously followed it no longer does. It often involves new learning rather than deletion, helping explain why an old response can return.

Habit stacking. The popular name for using one reliable action as the cue for another, such as flossing after brushing. It is a cue-response plan, not evidence that the added action has already become habitual.

Renewal. Return of a response when the context changes after extinction, often towards the setting where learning first occurred. Much evidence comes from animal research and requires careful translation.

Habit substitution. Training a different response to a familiar cue while reducing the old behaviour. Substitution can be useful when the cue persists, but it is not the only breaking strategy.

Basal ganglia. Interconnected brain structures involved in action selection, movement, learning and motivation. They contribute to habit-related control but do not form a single habit centre or explain behaviour alone.

Go Deeper

The accessible synthesis. Wendy Wood, *Good Habits, Bad Habits: The Science of Making Positive Changes That Stick* (Farrar, Straus and Giroux, 2019). Wood is one of the central researchers in modern habit psychology and writes for ordinary readers without turning the subject into one guaranteed formula. The book is especially good on context, friction and why apparent self-control often reflects well-arranged environments. Read it in full for a fuller practical account and for the experiments behind many claims in this book. Its examples range beyond the narrow health behaviours that dominate much formation research, though the evidence remains stronger for some mechanisms than for long-term intervention outcomes.

The historical source. William James, *The Principles of Psychology*, volume 1, chapter IV, “Habit” (Henry Holt, 1890). The chapter is short, forceful and one of the reasons later discussions sound familiar. James connects repeated conduct, skill, education and social order, then gives advice about launching and protecting new practices. Read the psychology and rhetoric; treat the neural account as nineteenth-century history rather than current neuroscience. His intolerance of exceptions is bracing and too absolute, which makes the chapter useful to argue with. It shows that the moral language surrounding habit arrived long before apps, streaks and dopamine slogans.

The formation study. Phillippa Lally, Cornelia H. M. van Jaarsveld, Henry W. W. Potts and Jane Wardle, “How Are Habits Formed: Modelling Habit Formation in the Real World”, *European Journal of Social Psychology* 40, no. 6 (2010): 998-1009. This is the paper behind the famous 66-day claim and the best way to see what the study did rather than what headlines made of it. Read the individual curves, range and treatment of missed opportunities. The warning is scale: 96 volunteers, self-selected health behaviours, twelve weeks and self-reported automaticity, with some estimates extending beyond direct observation.

The current corrective. Benjamin Gardner, Amanda L. Rebar, Sanne de Wit and Phillippa Lally, “What Is Habit and How Can It Be Used to Change Real-World Behaviour? Narrowing the Theory-Reality Gap”, *Social and Personality Psychology Compass* 18, no. 6 (2024): e12975. This review is more technical but gives the clearest compact account of what the field means by habit, where laboratory and everyday definitions diverge, and why complex behaviour should not be forced into a habitual-or-deliberate binary. It is especially valuable on overriding impulses, instigation versus execution, context change and the absence of one universally best strategy for breaking habits.

Notes and Sources

Habit research uses several traditions that do not line up perfectly. Animal learning studies can manipulate actions, cues and outcomes tightly. Human laboratory tasks test related distinctions under artificial conditions. Field studies observe ordinary routines but often depend on self-report. The account here uses convergence across those methods and avoids treating any one measure as the definition of habit. All unnamed everyday, workplace and clinical-adjacent scenarios are illustrative rather than reported case histories. Scientific and bibliographic claims were rechecked on 5 September 2026.

Definition, automaticity and control

The working definition follows Gardner, Rebar, de Wit and Lally's 2024 review and Wood and R  nger's 2016 synthesis: repeated performance in recurring contexts can form context-response associations that generate an impulse or readiness to act when the context returns. The visible behaviour is not itself the habit. Habit is a mode or influence of control, and the same action can be habitual on one occasion and deliberate on another.

Automaticity has several features, including speed, efficiency, limited awareness and limited intention, which need not appear together. The manuscript therefore avoids using automatic as a synonym for unconscious or compulsory. A cue-triggered impulse can be noticed, inhibited or overridden. This distinction also protects the boundary with addiction, obsessive-compulsive disorder and other clinical conditions.

The examples involving an old route, password, app position or cupboard are ordinary illustrative cases of action slips, not documented anecdotes. Norman's work on action slips supplies the general category. No claim is made that every error of this kind proves a fully formed habit.

Formation, timing and missed opportunities

Lally, van Jaarsveld, Potts and Wardle followed 96 volunteers who chose a daily eating, drinking or activity behaviour and attempted it in a stable context for twelve weeks. Eighty-two participants supplied enough data for modelling. The model could be fitted for 62, and 39 met the authors' good-fit criterion. In those 39 cases, estimated time to reach 95 per cent of the fitted automaticity asymptote ranged from 18 to 254 days. Some estimates extended beyond the 84-day observation window. The often quoted 66 days was a median in the fitted sample, not a universal threshold. The authors also found that one missed opportunity did not materially alter the fitted formation process. That result does not show that repeated omission is harmless.

Keller and colleagues randomised 192 adults to connect an everyday nutrition behaviour to either a daily routine or a clock time. Participants reported daily for 84 days. Both groups increased plan enactment and automaticity, with no reliable difference between cue types. Only 27 of 117 protocol-adherent participants met the paper's criterion for successful asymptotic formation; their modelled median was 59 days, with a much wider range. The enrolled sample was 86.5 per cent female and had a mean age of about 25. That median applies to the selected successful-former subgroup, not to all participants or all habits.

Singh and colleagues' 2024 systematic review included 20 health-behaviour studies and 2,601 participants. Only four studies reported formation time, using differing methods. Eleven studies were rated at high risk of bias. Individual estimates ranged from 4 to 335 days; some formation estimates were model-based extrapolations. These are not comparable readings from a single clock and do not establish a timetable for reading, writing, relationships or skilled work.

The 21-day story comes from Maxwell Maltz's *Psycho-Cybernetics*. Maltz described a minimum of about 21 days in observations about adjustment to altered appearance, changed circumstances and mental self-image. He did not report a controlled study of context-linked behavioural automaticity.

Consequences, reward and dopamine

Thorndike's puzzle-box work introduced the law of effect: responses followed by satisfying consequences became more likely under related conditions. Skinner developed a broader experimental analysis of operant behaviour, reinforcement schedules, shaping and stimulus control. The book uses this history to explain selection by consequences, not to claim that human routines can be reduced to animal chamber behaviour.

James's discussion is in chapter IV of the first volume of *The Principles of Psychology* (1890). His advice against exceptions and his conservative social claims are paraphrased, not endorsed as modern evidence. He describes habit as keeping miners at work and protecting the fortunate from unrest among the poor. The paragraph drawing a distinction between reliable routine and fair institutions is this book's interpretation, not a modern argument attributed to James.

Reward is used in the learning sense rather than as a compulsory visible treat. Relief, progress, social response and the removal of irritation can support repetition. Immediate consequences are often easier to connect to an action than delayed ones, but the exact effect depends on the behaviour, person and setting.

The account of dopamine follows Schultz, Dayan and Montague's 1997 paper and Schultz's 2016 review. In important reward-learning settings, phasic dopamine activity can reflect reward prediction errors: differences between expected and obtained outcomes. This does not make dopamine a pleasure reservoir, a moral score or a single explanation for habit. Balleine and O'Doherty, Seger and Spiering, and Tricomi, Balleine and O'Doherty support the broader account of distributed corticostriatal involvement and the absence of one habit centre.

Goal-directed action and outcome devaluation

Dickinson's 1985 synthesis is the main historical source for the distinction between action-outcome control and behavioural autonomy. Outcome devaluation asks whether performance falls after an expected outcome becomes less valuable. Contingency degradation asks whether performance changes when the action no longer controls the outcome. These procedures have produced robust distinctions in animal research under defined conditions. Moore and colleagues' 2026 study of male mice used repeated within-animal measurement and found a sharp transition over roughly three trials in one auditory go-or-no-go task after discrimination had stabilised. Outcome-devaluation tests, dorsolateral-striatum lesions and neural measurements supported their interpretation. The result establishes a task-specific counterexample to universally gradual transition, not a human formation timetable.

Translation to humans is less settled. Vázquez-Millán, Martínez-López, Rueda, León and Luque reported in July 2026 that apparent habit-like performance in a human task was concentrated among participants for whom devaluation itself was ineffective. Their reanalysis of earlier datasets raised the same concern. The manuscript does not take this as proof that human habits do not exist. It treats it as evidence that one common laboratory detector can misclassify goal-directed action.

The context-response account is not uncontested. Kruglanski and Szumowska argue that habitual behaviour remains goal-driven and sensitive to goal value and expected attainability. The manuscript retains the context-response definition used by current real-world habit reviews while presenting goal-directed and habitual control as interacting influences, not mutually exclusive boxes.

Complex routines, plans and identity

Phillips and Gardner studied 123 adults and found that habitual exercise instigation predicted exercise frequency more clearly than habitual execution. Gardner, Phillips and Judah developed the broader distinction between instigating and carrying out complex behaviours. These findings support the claim that a routine can begin habitually while execution remains effortful, skilled and responsive to feedback. They do not establish that every exercise routine has this structure.

Implementation intentions are if-then plans that connect a specified opportunity with a specified action. Gollwitzer and Sheeran's meta-analysis covered 94 independent tests and found a positive average effect on goal attainment. The book does not treat implementation intentions as proof of habit formation. A plan can continue to guide action directly, and successful performance may remain deliberate.

Verplanken and Sui argue that identity and habit can reinforce one another. Zhu and colleagues' 2025 review of 19 articles and 13,340 participants found a sizeable association across health behaviours, while noting limited predictive evidence and no secure unidirectional causal account. The manuscript therefore treats identity as interpretation, motivation and social organisation around behaviour, not as a replacement for cue, repetition and opportunity.

Context, friction and opportunity

Wood, Quinn and Kashy's two 2002 diary studies sampled university students' behaviour, thoughts and feelings across the day. Around two-fifths of sampled actions were frequently repeated in stable contexts, and more habitual behaviour was associated with thoughts directed elsewhere. Rebar, Vincent, Kovac Le Cornu and Gardner's ecological momentary assessment, published online in 2025 and assigned to a 2026 journal issue, sampled 105 adults in the United Kingdom and Australia six times daily for seven days. Participants classified 65 per cent of sampled behaviours as habitually instigated, 88 per cent as habitually executed and 76 per cent as intentional. The percentages are not compared as one trend: the studies used different samples, prompts, definitions and self-reports. Together they show how strongly prevalence estimates depend on measurement.

Wood, Tam and Guerrero Witt followed students through changes in everyday context. Behaviour transferred more reliably where supporting features of the old context remained stable. This supports context dependence and habit discontinuity without implying that relocation erases every old association.

Friction is used as a practical description of effort, delay, uncertainty and social cost, not as one standardised scientific variable. The examples about visibility, passwords, equipment, defaults and room arrangement are illustrative applications of the broader opportunity and context model. Michie, van Stralen and West's COM-B framework supplies the explicit reminder that behaviour also requires capability and opportunity. Stable time, space, safety, money and authority are distributed unequally.

Breaking, extinction and return

Gardner and colleagues' 2024 review rejects one universally best method for breaking habits. Their 2021 paper on weight-loss maintenance distinguishes stopping habitual behaviour from erasing an underlying habit. Edgren, Baretta and Inauen's 2026 randomised trial of 313 adults found a faster first-week fall in self-reported unhealthy-snacking automaticity among intervention groups assigned substitution, inhibition or reduced accessibility, but no clear overall superiority among strategies or reward conditions. Interpretation is limited by uneven adherence, 52 per cent completion of scheduled habit-strength reports, a predominantly female self-selected sample and reliance on self-report. Avoidance, friction, inhibition, context change and substitution may each help under different conditions.

The terms extinction, spontaneous recovery and renewal come chiefly from experimental learning research. Bouton's 2024 review explains why reduction in performance need not mean deletion and why context can control return. Much of this evidence is animal and laboratory based. The practical inference is bounded: plan for an old response to reappear in old conditions rather than assuming a quiet association has been destroyed.

All lapse, substitution and recovery examples in the manuscript are hypothetical. They are intended to expose different control problems, not to report treatment outcomes. Substance dependence, withdrawal, compulsive behaviour and severe impairment remain outside the scope of a general habit book.

Measurement

Verplanken and Orbell created the Self-Report Habit Index, which combined repetition, automaticity and identity-related items. Gardner, Abraham, Lally and de Bruijn later validated a shorter automaticity subscale. These tools make intensive field research possible but rely on people reporting a process partly characterised by reduced deliberation. Frequency, familiarity and fluency can influence responses.

No single measure certifies a habit. Behaviour counts can miss control;

self-reports can blur experience and inference; laboratory tasks can impose unfamiliar rules; digital traces can record timing while missing context and purpose. These approaches can inform one another, but they should not be treated as interchangeable tests of the same thing.

Compounding arithmetic

The numerical comparison is direct arithmetic. 1.01^{365} is approximately 37.7834 and 0.99^{365} is approximately 0.02552. Five pounds a day is £1,825 over 365 days, and thirty minutes a day is 182.5 hours. The exponential calculation is not empirical evidence about improvement. It assumes identical proportional change, complete retention, multiplication of the retained result and no ceiling, interaction or interruption.

The manuscript distinguishes additive accumulation, maintenance, thresholds and compounding. A threshold is not itself compounding. Earlier gains can contribute to later returns, for example when new capability enables more productive practice, but that is a conditional feedback mechanism, not an experimentally established universal growth law. The practical examples are explanatory inferences: actions must recur, gains must persist, and the surrounding system must not cancel them.

Current synthesis and limits

Gardner, Rebar and Zhang's 2025 editorial review was used to check the field's current real-world application claims. Voelkel, Milkman and Duckworth's *Behavior Change*, first posted as a Review in Advance on 7 August 2026, was consulted for the wider sequence from motivation through follow-through to durable behaviour change. The publisher currently cites it as *Annual Review of Psychology* 78, in press; no page range is asserted. Current scientific claims and bibliographic status were rechecked on 5 September 2026.

The strongest unresolved limitation is external validity. Real-world formation and degradation evidence remains concentrated in self-selected health behaviours, motivated participants and automaticity questionnaires. The book extends converging mechanisms cautiously to domestic, work and

social routines, and labels organisational examples as applications rather than direct trials. Those wider settings still lack equally strong formation evidence.

Bibliography

Historical and primary works

James, William. *The Principles of Psychology*. Vol. 1. New York: Henry Holt, 1890.

Maltz, Maxwell. *Psycho-Cybernetics: A New Way to Get More Living Out of Life*. Englewood Cliffs, NJ: Prentice-Hall, 1960.

Pavlov, Ivan P. *Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex*. Translated and edited by G. V. Anrep. London: Oxford University Press, 1927.

Skinner, B. F. *The Behavior of Organisms: An Experimental Analysis*. New York: Appleton-Century, 1938.

Thorndike, Edward L. "Animal Intelligence: An Experimental Study of the Associative Processes in Animals." *Psychological Review Monograph Supplements* 2, no. 4, Whole No. 8 (1898).

Modern research and synthesis

Balleine, Bernard W., and John P. O'Doherty. "Human and Rodent Homologies in Action Control: Corticostriatal Determinants of Goal-Directed and Habitual Action." *Neuropsychopharmacology* 35, no. 1 (2010): 48-69. doi:10.1038/npp.2009.131.

Bouton, Mark E. "Habit and Persistence." *Journal of the Experimental Analysis of Behavior* 121, no. 1 (2024): 88-96. doi:10.1002/jeab.894.

Dickinson, Anthony. "Actions and Habits: The Development of Behavioural Autonomy." *Philosophical Transactions of the Royal Society of London B* 308, no. 1135 (1985): 67-78. doi:10.1098/rstb.1985.0010.

Edgren, Robert, Dario Baretta, and Jennifer Inauen. "Habit Degradation Strategies Promote Faster Early Reductions in Unhealthy Snacking Habit Strength in Intensive Longitudinal Randomised Controlled Trial." *Communications Psychology* 4 (2026): article 67. doi:10.1038/s44271-026-00432-9.

Gardner, Benjamin, Charles Abraham, Phillippa Lally, and Gert-Jan de Bruijn. "Towards Parsimony in Habit Measurement: Testing the Convergent and Predictive Validity of an Automaticity Subscale of the Self-Report Habit Index." *International Journal of Behavioral Nutrition and Physical Activity* 9 (2012): 102. doi:10.1186/1479-5868-9-102.

Gardner, Benjamin, L. Alison Phillips, and Gaby Judah. "Habitual Instigation and Habitual Execution: Definition, Measurement, and Effects on Behaviour Frequency." *British Journal of Health Psychology* 21, no. 3 (2016): 613-630. doi:10.1111/bjhp.12189.

Gardner, Benjamin, Rebecca Richards, Phillippa Lally, Amanda L. Rebar, Tanya Thwaite, and Rebecca J. Beeken. "Breaking Habits or Breaking Habitual Behaviours? Old Habits as a Neglected Factor in Weight Loss Maintenance." *Appetite* 162 (2021): 105183. doi:10.1016/j.appet.2021.105183.

Gardner, Benjamin, Amanda L. Rebar, Sanne de Wit, and Phillippa Lally. "What Is Habit and How Can It Be Used to Change Real-World Behaviour? Narrowing the Theory-Reality Gap." *Social and Personality Psychology Compass* 18, no. 6 (2024): e12975. doi:10.1111/spc3.12975.

Gardner, Benjamin, Amanda L. Rebar, and Chun-Qing Zhang. "Making Health a Habit: Progress in Habit Theory and Its Application in Real-World Settings." *Applied Psychology: Health and Well-Being* 17, no. 4 (2025): e70064. doi:10.1111/aphw.70064.

Gollwitzer, Peter M., and Paschal Sheeran. "Implementation Intentions and Goal Achievement: A Meta-Analysis of Effects and Processes." *Advances in Experimental Social Psychology* 38 (2006): 69-119. doi:10.1016/S0065-2601(06)38002-1.

Keller, Jan, Dominika Kwasnicka, Patrick Klaiber, Lena Sichert, Phillippa Lally, and Lena Fleig. "Habit Formation Following Routine-Based versus Time-Based Cue Planning: A Randomized Controlled Trial." *British Journal of Health Psychology* 26, no. 3 (2021): 807-824. doi:10.1111/bjhp.12504.

Kruglanski, Arie W., and Ewa Szumowska. "Habitual Behavior Is Goal-Driven." *Perspectives on Psychological Science* 15, no. 5 (2020): 1256-1271. doi:10.1177/1745691620917676.

Lally, Phillippa, Cornelia H. M. van Jaarsveld, Henry W. W. Potts, and Jane Wardle. "How Are Habits Formed: Modelling Habit Formation in the Real World." *European Journal of Social Psychology* 40, no. 6 (2010): 998-1009. doi:10.1002/ejsp.674.

Michie, Susan, Maartje M. van Stralen, and Robert West. "The Behaviour Change Wheel: A New Method for Characterising and Designing Behaviour Change Interventions." *Implementation Science* 6 (2011): 42. doi:10.1186/1748-5908-6-42.

Moore, Sharlen, Zyan Wang, Ziyi Zhu, Joy Wang, Ruolan Sun, Yeonjae A. Lee, Adam Charles, and Kishore V. Kuchibhotla. "Revealing Abrupt Transitions from Goal-Directed to Habitual Behavior." *Nature Communications* 17 (2026): article 4751. doi:10.1038/s41467-026-71048-0.

Norman, Donald A. "Categorization of Action Slips." *Psychological Review* 88, no. 1 (1981): 1-15. doi:10.1037/0033-295X.88.1.1.

Phillips, L. Alison, and Benjamin Gardner. "Habitual Exercise Instigation (vs. Execution) Predicts Healthy Adults' Exercise Frequency." *Health Psychology* 35, no. 1 (2016): 69-77. doi:10.1037/hea0000249.

Rebar, Amanda L., Grace Vincent, Katya Kovac Le Cornu, and Benjamin Gardner. "How Habitual Is Everyday Life? An Ecological Momentary Assessment Study." *Psychology & Health* 41, no. 9 (2026): 1507-1532. Published online 18 September 2025. doi:10.1080/08870446.2025.2561149.

Schultz, Wolfram. "Dopamine Reward Prediction Error Coding." *Dialogues*

in Clinical Neuroscience 18, no. 1 (2016): 23-32.
doi:10.31887/DCNS.2016.18.1/wschultz.

Schultz, Wolfram, Peter Dayan, and P. Read Montague. "A Neural Substrate of Prediction and Reward." *Science* 275, no. 5306 (1997): 1593-1599. doi:10.1126/science.275.5306.1593.

Seger, Carol A., and Brian J. Spiering. "A Critical Review of Habit Learning and the Basal Ganglia." *Frontiers in Systems Neuroscience* 5 (2011): 66. doi:10.3389/fnsys.2011.00066.

Singh, Ben, Andrew Murphy, Carol Maher, and Ashleigh E. Smith. "Time to Form a Habit: A Systematic Review and Meta-Analysis of Health Behaviour Habit Formation and Its Determinants." *Healthcare* 12, no. 23 (2024): 2488. doi:10.3390/healthcare12232488.

Tricomi, Elizabeth, Bernard W. Balleine, and John P. O'Doherty. "A Specific Role for Posterior Dorsolateral Striatum in Human Habit Learning." *European Journal of Neuroscience* 29, no. 11 (2009): 2225-2232. doi:10.1111/j.1460-9568.2009.06796.x.

Vázquez-Millán, Antonio, Pablo Martínez-López, María Rueda, José J. León, and David Luque. "The Evaluation of Devaluation: Deficient Outcome Devaluation Leads to Wrongly Considering Goal-Directed Actions as Habits." *Behavior Research Methods* 58 (2026): article 224. doi:10.3758/s13428-026-03099-6.

Verplanken, Bas, and Sheina Orbell. "Reflections on Past Behavior: A Self-Report Index of Habit Strength." *Journal of Applied Social Psychology* 33, no. 6 (2003): 1313-1330. doi:10.1111/j.1559-1816.2003.tb01951.x.

Verplanken, Bas, and Jie Sui. "Habit and Identity: Behavioral, Cognitive, Affective, and Motivational Facets of an Integrated Self." *Frontiers in Psychology* 10 (2019): 1504. doi:10.3389/fpsyg.2019.01504.

Voelkel, Jan G., Katherine L. Milkman, and Angela L. Duckworth. "Behavior Change." *Annual Review of Psychology* 78 (2026): in press. Review in Advance first posted 7 August 2026.

doi:10.1146/annurev-psych-031626-111545.

Wood, Wendy. *Good Habits, Bad Habits: The Science of Making Positive Changes That Stick*. New York: Farrar, Straus and Giroux, 2019.

Wood, Wendy, Jeffrey M. Quinn, and Deborah A. Kashy. "Habits in Everyday Life: Thought, Emotion, and Action." *Journal of Personality and Social Psychology* 83, no. 6 (2002): 1281-1297.

doi:10.1037/0022-3514.83.6.1281.

Wood, Wendy, Leona Tam, and Melissa Guerrero Witt. "Changing Circumstances, Disrupting Habits." *Journal of Personality and Social Psychology* 88, no. 6 (2005): 918-933. doi:10.1037/0022-3514.88.6.918.

Wood, Wendy, and Dennis R  nger. "Psychology of Habit." *Annual Review of Psychology* 67 (2016): 289-314.

doi:10.1146/annurev-psych-122414-033417.

Zhu, Lianghao, Yingying Tao, Yi Guo, Xuran Zhang, Ting Wang, Bojun Zhou, Geng Li, and Liancheng Zhang. "The Relationship between Habit and Identity in Health Behaviors: A Systematic Review and Three-Level Meta-Analysis." *Applied Psychology: Health and Well-Being* 17, no. 2 (2025): e70017. doi:10.1111/aphw.70017.