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Breaches in the Flow: A Mismatch Model of Micro-Decisions in Everyday Activity

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Abstract

In daily tasks, activity runs as a semi-automatic flow, channelled by the setting. We studied what happens when this flow breaks. Sixty adults recorded their everyday activities with miniature wearable first-person cameras and commented on the recordings in replay interviews (Subjective Evidence-Based Ethnography). We analysed 3,212 breaches, linking visible initial behavioural markers, subsequent behaviours and participants' accounts of whether they decided. The flow broke about 55 times an hour; 75.8% of breaches were experienced as decisions. Breaches with pause, hesitation or scan, but no retry or give up, were experienced as decisions in 91.9% of cases; breaches with retry or give up, but none of the other three markers, in 16.7%. This contrast remained in both additional coders' final codes, among the 51 participants who completed reinforced replay interviews, and within 47 of 49 participants with breaches in both groups. Overall, seven retries in ten succeeded. We summarise these trajectories in a flowchart and propose a mismatch model. Activity is a perception–action spiral in which feed-forward and feedback are continuously compared. A mismatch that cannot be absorbed within the action calls for the lowest sufficient level of control, a principle of subsidiarity. In this model, a decision occurs when the actor must set

the next subgoal. The findings distinguish breaches in ongoing activity from the experience of deciding and identify behavioural patterns associated with that experience.

Keywords: micro-decision; everyday life; activity theory; prediction error; subsidiarity; Subjective Evidence-Based Ethnography.

1 Introduction

Most of everyday life runs on a kind of autopilot. We walk, cook, clean and shop without deciding at every step. To the continuous question “now what?”, that is, which behaviour the subject should engage in, the setting (the situation and the context) usually provides the next step. “Installations” in the setting channel behaviour through physical affordances, embodied competences and social regulation (Lahlou, 2017). They leave the subject a reduced number of possibilities, among which usually a single one is the one the subject is expected to take. This produces the rather fluid trajectories of behaviour that we can observe, and that each of us tends to follow in everyday life: how we prepare breakfast, how we dress, how we go to work, etc. The image of activity as a flow is old. Dewey (1922) described conduct as running on habits; when a habit is blocked, emotion and reflection arise while the habit readjusts. Valsiner (2008) stressed that this flow is not a homogeneous stream: it is regulated, at several levels, by structures that people build themselves.

Yet the flow breaks constantly. A lid does not turn, a product is not on the shelf, a bin liner tears. In the material analysed here, the everyday activity of ordinary people, the flow of activity broke about once a minute (Oraee, 2024). Some of these breaches were experienced as decisions. Others were not. In some cases, subjects continued as planned; in others they did not. Understanding what happens at these joints of activity matters, because these small reorientations have massive implications. Whether people take the stairs or the lift, whether they buy this or that product, whether they go on or stop: at scale, such behaviours have a huge impact on health, the environment and economic life in general. These small choices are also the target of most behavioural interventions. We

therefore need to understand better what happens at these joints of activity, where several alternatives are available to the subject.

The moments where a subject is confronted with choices come in many forms. They have been studied by different traditions, and it is unclear whether these choices are resolved by the same mechanisms. These moments vary along at least two dimensions: situatedness and importance. Some choices are very situated and local: they depend on the material environment at hand: for example, choosing between pulling or pushing this door. Others are abstracted from the context, such as answering a questionnaire, or choosing in a laboratory experiment between 10 euros right now or 20 euros in a year. Choices are also more or less important: choosing between strawberry and vanilla ice cream is less important than deciding whether to send water-bombing aircraft to stop a forest fire. At least four regimes can likely be distinguished. The first is the channelled autopilot, which runs most of daily life. The second is the micro-decision, which occurs when the autopilot fails and the next step must be set on the spot, mostly by exploring the environment. The third is classic decision-making: a complex problem is then addressed mainly by mental simulation, in a problem space that the subject (or the experimenter) sets up (Newell & Simon, 1972). “Big life decisions” such as buying a house or choosing a spouse (Camilleri, 2023) belong here. The fourth concerns big problems that arise in the situation itself, such as emergencies in natural catastrophes, or war. In those, expertise appears paramount, and experts act on their recognition of the situation (Klein et al., 1986). The limits between these regimes are blurry, and several mechanisms are probably at work in all of them. We focus here on the least important and most situated choices. They are also among the least explored, because they are difficult to observe in real, naturalistic settings: they depend so much on the material setting that they can hardly be studied in controlled laboratory conditions.

This paper studies what happens at these joints in activity by analysing what happens at breaches in the flow of actions in ordinary everyday life. We recorded everyday activities with first-person, miniature wearable cameras and replay interviews, a method called Subjective Evidence-Based Ethnography (Lahlou et al., 2015), described in the Material and methods

section. Here we analysed the succession of behaviours during and after 3,212 breaches, which occurred in the recorded natural activity of 60 participants. Recorded activities included cleaning, cooking, rearranging and organising, commuting, shopping, eating and drinking, social media use, walking, reading and other daily tasks.

The behaviour was coded by an observer, and the codes were checked with the participants. We also collected the subjects' experience, using the re-enactment effect: cued by watching the recording of their activity from their own perspective, participants can recall and describe their experience at the time of action. This gives us the criterion used here to classify a "decision": what the subjects themselves designate as such when they comment on that specific moment.

It turns out that in practice not all breaches give rise to decisions, and that there are other ways to continue the activity. But a majority of breaches do give rise to decisions. We study in detail the succession of actions at these joints, and draw a flowchart of the trajectories (Section 4.5). We then propose a model (Section 5) accounting for the trajectories observed at a breach. The model rests on two main hypotheses. First, a mismatch between what is expected and what is perceived is what halts the spiralling perception–action loop of activity: the model treats a breach as a mismatch, unless that breach is simply the completion of an activity before passing to another. Second, breaches are resolved by escalation, following a principle of subsidiarity: more extensive processes are recruited as the lower ones fail to solve the situation, so an error is handled at the lowest level able to absorb it. A decision occurs when a good subgoal is not already provided by the flow and has to be set by the actor. It addresses the mismatches that the subject evaluates as requiring a reset of the task; in practice, the reset can set a new goal, or reinstate the same goal with a different path.

We first review the precursors of this question. We then describe the pathways followed by our participants and their successive steps, present the model, and discuss how it sits in the literature of several traditions: the psychology of activity, the physiology of action, the study of human performance, the neuroscience of control and decision science. Our

contribution is to distinguish breaches in everyday activity from the experience of deciding, and to quantify how decision reports vary with the behaviours used to respond to these breaches.

2 Precursors

The question of what happens when the flow of activity breaks is old. Several traditions have addressed parts of it, at different levels of description. We review them briefly, because the model draws on each of them.

2.1 Thinking starts at a blocked act

Dewey placed the origin of reflective thought in a disturbed activity. Thinking begins in “a forked-road situation, a situation which is ambiguous, which presents a dilemma, which proposes alternatives” (Dewey, 1910, p. 11). In Human Nature and Conduct, deliberation “starts from the blocking of efficient overt action” (Dewey, 1922, p. 190). It is “a dramatic rehearsal (in imagination) of various competing possible lines of action” (p. 190). Dewey did not say which blockings lead to deliberation, and which do not. This is a question we address here.

2.2 Interrupted actions

Lewin’s school studied interrupted actions experimentally. Ovsiankina (1928) showed that people tend to resume an interrupted task when they are free to do so. Lewin (1935) explained this by a quasi-need: a tension that persists until the goal is reached. This matters for what follows a breach. Some breaches are not resolved on the spot but parked. For example, a participant (P33), back from shopping found the fridge too full, left the rest of the groceries on the counter, and reported completing the task later in the evening.

2.3 Anticipation and correction of action

Russian physiology described the control of movement as a loop of anticipation and comparison. For Bernstein (1967), a movement is not a fixed command sent to the muscles. It is guided by a model of the required future and corrected continuously by sensory feedback. Corrections are organised in levels. Lower levels handle routine adjustments in the background, while a leading level handles the meaning of the action (Bernstein, 1996).

Anokhin (1974) described the functional system, organised by the result it must reach. Its architecture has stages: an afferent synthesis, which brings together motivation, memory, the situation and the trigger; a stage of “decision making”, which keeps one form of action; the acceptor of action results, an image of the expected result formed before the action; the action; and the result, compared with the acceptor through return afferentation (Sudakov, 1998). A match ends the stage. A mismatch triggers an orienting-investigative reaction, a new afferent synthesis and a new decision (Sudakov & Zilov, 1975). In this physiological scheme every act involves a decision: the nervous system selects a programme of action, and this selection need not be experienced. We study the experienced decision. Toomela (2010) drew from this theory that orientation to the future is a basic property of living systems. Alexandrov (2008) extended this view: behaviour is fragmented into units defined by their results, as seen from inside the subject. These accounts already contain the comparison and the levels of our model. They concern the physiological organisation of action, not the experience of deciding.

2.4 Comparison loops and prediction error

Miller et al. (1960) made the same loop the unit of behaviour: test, operate, test again, exit (TOTE). Control theory extended it to goals: the agent compares the perceived state with a reference and acts to reduce the difference (Carver & Scheier, 1982, 1998; Powers, 1973). Predictive processing generalised the idea to perception. The brain continuously predicts its sensory input, and only the prediction error, the part of the input that the prediction fails to

explain, is passed on (Clark, 2013; Friston, 2010; Rao & Ballard, 1999). An error can be reduced in two ways: by updating the model, or by acting so that the input matches the prediction (Clark, 2013).

In motor control, a feed-forward signal anticipates the sensory consequences of an action, and the feedback from the senses is compared with it (Wolpert et al., 1998). We use "feed-forward" and "feedback" in this sense. A prediction error is a mismatch between the two. Our model uses the broader term "mismatch", because some breaches do not come from a failed prediction (see below). (In predictive coding, the same words name the direction of connections in the cortical hierarchy: the feed-forward connections carry the prediction error upwards. We do not use them in that other sense.)

2.5 Activity, operations and installations

We use activity theory (Leontiev, 1978; Rubinstein, 1922/2007; see also Abulkhanova, 2007; Barabanschikov, 2007; Nosulenko et al., 2005) in a simplified version (Lahlou, 2024; Nosulenko & Samoylenko, 2009). The subject tries to satisfy motives by reaching goals. A goal is a conscious representation of a final desired state, for example eating a meal at a restaurant to satisfy hunger. To reach the goal, the subject moves step by step from one subgoal to the next. Getting to the next subgoal is a small problem: a task. A task is resolved by action. For example, the action of unlocking the door resolves the task of reaching the subgoal "door open". The moments where a subject moves from one subgoal to the next are the "joints" of activity. At each joint, a reorientation can take place. Each subgoal, once reached, is a new starting point, and the next subgoal orients and feeds forward the activity.

Activity theory distinguishes conscious actions from operations, which were once actions but now run automatically (Leontiev, 1978). An operation can become an action again when its conditions change. For an experienced driver, changing gear is an operation. When the gearbox jams, it becomes an action again. This is a "breach in the flow" in our sense. Automatisation makes decisions hard to observe from outside. Clearly, we do not consider

taking another step while walking “a decision”. But deliberately choosing a route around roadworks is one. Between the two lies a grey zone.

Studies of the readiness potential show that cerebral preparation can precede the reported intention to act (Haggard, 2019; Libet et al., 1983). Here we study the experience of deciding. What an external observer sees is *behaviour*; what the subject lives is *activity* (Lahlou, 2017, pp. 425–426).

Habit research examines repeated behaviours that bypass deliberation (Lally et al., 2010; Verplanken & Orbell, 2003; Wood & Rünger, 2016). Its focus is the automaticity of the action itself, not the points of transition between actions. A person in a habitual cleaning routine still meets points where the flow breaks, or where the next step must be chosen. These transition points are not habits. They are the seams between habits.

The setting also decides how often the flow breaks. Valsiner (1987) described how the social environment channels action through a zone of free movement, the actions accessible in a setting, and a zone of promoted action, those that others encourage. Installation Theory adds that behaviour is channelled by installations, which combine physical affordances, embodied competences and social regulation (Lahlou, 2017). In a familiar installation, the next subgoal is given by the setting, and the flow rarely breaks.

2.6 Adjustment within the action

Much of the comparison runs without any experience of it. Gibson (1979) described perception as the direct pickup of what the environment affords for action, without inference or memory. For example, people see whether a stair is climbable from the ratio of riser height to leg length (Warren, 1984). Within the action, small differences are absorbed by adjusting the movement. Studies of speech produced while holding a bite-block in the mouth show this adjustment is quick and precise (Kelso et al., 1984; Lindblom et al., 1979). Activity theory relates actions to goals and operations to conditions: when the conditions vary a little, the operation adapts, and the action itself is unchanged (Leontiev, 1978).

2.7 Levels of control in human performance

Suchman (1987), studying situated action, found that subjects first rely on their embodied skills, and turn to plans when that does not work. Research on human reliability reached a similar view from the study of operators and their errors. Rasmussen (1983) distinguished three levels of behaviour. Skill-based behaviour runs on automated patterns, without conscious control. Rule-based behaviour applies a stored rule, recognised from signs in the situation. Knowledge-based behaviour addresses an unfamiliar problem with a mental model and explicit goals. Reason (1990) described the transitions between levels. Skill-based behaviour runs until an attentional check detects a problem. Control then moves to the rule-based level and, if no rule fits, to the knowledge-based level. Norman and Shallice (1986) made a similar point: routine control runs until it proves inadequate, and a supervisory system then intervenes. Interestingly, some organisations apply a similar approach with escalation of customer online technical support to higher levels with more skilled operators.

2.8 Levels of control in the brain

Cognitive control is also organised hierarchically. In the cascade model of the lateral prefrontal cortex, premotor regions handle sensorimotor control, posterior regions handle control by the immediate context, and anterior regions handle control by the episode and the current goals (Koechlin et al., 2003). Higher levels supply contextual or episodic information when stimuli alone are insufficient for action selection (Koechlin & Summerfield, 2007). This resembles a principle of subsidiarity. The brain monitors the reliability of the current strategy, switches to a strategy held in memory when the current one fails, and creates a new one when no currently monitored strategy appears reliable (Collins & Koechlin, 2012; Donoso et al., 2014).

The cascade model is anatomically precise. Premotor regions select actions in response to stimuli. Posterior lateral prefrontal regions (BA 44/45) select stimulus–response associations according to the immediate perceptual context. Anterior lateral prefrontal

regions (BA 46) select task sets according to the temporal episode, that is, according to past events or ongoing goals (Koechlin et al., 2003). Collins and Koechlin (2012) describe task sets as composite internal models, with selective, predictive and contextual components. The anterior cingulate cortex monitors conflict between competing processing pathways. When two incompatible responses are activated at once, it signals the dorsolateral prefrontal cortex, which increases top-down control (Botvinick et al., 2001).

2.9 Not deciding

People do not always decide when a choice is available. Janis and Mann (1977) described defensive avoidance as one way of coping with decisional conflict. When options conflict, people defer the choice, look for new options, or keep the default (Dhar, 1997; Tversky & Shafir, 1992). Anderson (2003) reviewed four forms of decision avoidance: choice deferral, status quo bias, omission bias and inaction inertia. People also stop searching when an option is good enough, which Simon (1956) called satisficing. These studies mostly offer participants a set of options, in the laboratory or in consumer settings. They do not observe breaches that nobody set up, in the course of everyday activity.

3 Material and methods

Studying decisions in everyday life raises a classic problem of psychology: access to introspection (Wundt, 1912). Self-report cannot capture decisions that people do not remember making, and introspective access to cognitive processes is limited (Nisbett & Wilson, 1977). Experience sampling interrupts the flow it aims to study, and so creates artificial decision points (Csikszentmihalyi & Larson, 1987; Hofmann et al., 2012). Thinking aloud may alter the processes it aims to observe (Ericsson & Simon, 1993). An external observer cannot know whether a breach was experienced as a choice.

Subjective Evidence-Based Ethnography (SEBE) was designed to address this problem. To understand behaviour, we must record the external conditions at the time of action, and

also what the subject experienced and how they interpreted the situation with their embodied competences. SEBE records behaviour first and obtains commentary afterwards, avoiding interruptions by questions during the activity. In the replay interview, sound and image from the first-person sequence of perception and action cue episodic memory (Lahlou, 2011; Tulving, 2002), helping the subject recall and describe the experience without the time pressure of the action (Lahlou et al., 2015). Decisions, in our data set, are therefore identified by the person who experienced them, not by an observer.

The material comes from a study reported in full in Oraee (2024). A purposive sample of 60 adults living in the UK (41 female, 19 male, aged 22–60, of diverse ethnic backgrounds) wore subcams, miniature cameras worn at eye level that record the wearer's perspective in wide-angle video with stereo sound (Lahlou, 1999). They recorded 57 hours 56 minutes of everyday activities in 175 clips. Participants chose typical activities and could review and edit out their recordings before sharing them, so they felt at ease with recording. Each participant then watched the footage with the researcher in a replay interview, and commented moment by moment on their thoughts, feelings and actions; they could pause and replay the footage *ad libitum*. All 60 participants had a standard replay interview (RIW), and 51 also had a reinforced replay interview (RRIW), in which they classified each breach with cards (Oraee, 2024). The replay interviews were also recorded in full, with the footage on screen, so that each comment can be linked to the moment it refers to. All the material was coded by hand. For each breach, the participant classified whether it had involved a decision. When this had not already been reported, the researcher asked: "Did you experience this instance as making a decision?" The researcher did not define "decision"; participants classified their own experience. This classification is the "decisional status" used throughout.

A breach is a point where the sequence of actions does not flow seamlessly. This definition may seem vague, but in practice the researcher did not find breaches difficult to identify, especially with the high-definition, stereo, first-person footage of the subcam. Breaches include interruptions of an action and open transitions, where an activity has ended and the next one is not yet set. We used several behavioural markers (see below) and also

the participants' own comments. The first author noted the breaches on the footage, and participants could add, reject, split or merge them during the replay interview. Decisions not connected to immediate motor actions may have been missed, for example a participant thinking about a big decision while walking to the supermarket. The design is naturalistic: breaches arise unprompted, and the participant can afterwards say whether each was experienced as a decision. This is a "natural experiment" (Lazurskii, 1997) approach.

The first author coded each breach from the recordings for five behavioural markers: pause (a temporary cessation or marked slowing of movement), hesitation (a faltering or a redirection at the onset of a movement), scan (a visual search of the environment, with head movements), retry (a new attempt at an action after a failed result) and give up (the current line of action is stopped before its goal is reached, with or without a decision). In the reinforced replay interview, participants checked these codes with the cards, so the final markers include their own view. These five markers are a first set, observable on the recordings; they are not exhaustive. Each breach was also coded for its source, self-initiated or external, and for up to three later behaviours, coded after the first response: continue, identify possibilities, create possibilities, shift, activity initiation, activity extinction and others. The five marker behaviours could also appear later in the sequence. Table 2 counts them as first responses to the breach, and anywhere in the breach; Table 3 counts them as later occurrences. When we report give up overall, each breach is counted once, wherever give up occurs. The coding system was developed through an exploratory study and a pilot study (Oraee, 2024). Appendix A gives the cues used for each marker and the coding conventions.

Two other researchers coded samples of the footage independently, with the same codebook. The participants were selected at random. Each researcher located and coded the breaches without seeing the first author's codes, and then conducted RIW and RRIW with these participants (Oraee, 2024). On matched breaches, their final codes agreed with the main dataset on the full set of marker labels in 84.5% and 77.0% of cases (κ = .80 and .71; 291 and 300 breaches). Agreement on decisional status alone was 90.7% and 89.0% (κ

= .81 and .75). Appendix A and Online Resource 2 give the matching rules and agreement for each code.

4 Results

The figures reported below are descriptive. They document the phenomena from which the model emerged: how often they occur, how participants experienced them, and what followed them. All figures come from the final dataset of 3,212 breaches (Appendix A). Coding was done by humans only, without AI assistance.

4.1 Markers and successions

Of the 3,212 breaches, 2,671 carried at least one of the five markers as an initial response. Scan was the most frequent (1,223 breaches, 38.1%), followed by hesitation (766, 23.8%), pause (431, 13.4%), retry (213, 6.6%) and give up (58, 1.8%). Twenty breaches carried two markers. In 541 breaches (16.8%), the initial label was None in 485 cases and I do not know in six; no label was selected in the remaining 50. In 474 of these, a shift was recorded as the first following behaviour. Thirty-one of the 541 later included a pause, hesitation or scan. One in three of the 541 was experienced as a decision. For illustration, the thesis describes a participant who was about to put vegetables in the pan but turned to washing them instead: “I looked at them [vegetables] and remembered that I haven’t washed them” (P12; Oraee, 2024, p. 291). This shift was experienced as a decision.

The markers are visible in the first-person footage. In a pause, the hands may stop and the visual field may stabilise. In a hesitation, a reaching or stepping movement falters before completion. In a scan, the head turns and the visual field sweeps the surroundings. In a retry, the same movement is repeated, often with an adjustment. In a give-up, the line of action is abandoned and the participant turns away. Participants described each marker in their own words in the replay interview; we provide examples below.

Pause, after a bin liner tore: “I pause for like, how long was it? It felt like 20 seconds or so, but I’m actually deciding what to do […] when I’m pausing, I’m trying to, like, visualise” (P42).

Hesitation, while adding salt: “I was about to add salt [to the dish], but then I hesitated, yeah. […] I was trying to remember if I had already added salt earlier or not […]. It took me a moment to decide. I think I eventually added just a small bit to be safe” (P27).

Scan: “I…I see that there is…clearly there’s a pause, but it’s not actually a pause, I’m scanning to see what to do” (P34).

Retry, with a jar: “I find the lid was too slippery, so I tried to open it, but I failed the first time, but then I tried it for a few times and there you go!” (P27).

Give up, while hoovering: “I try to get the machine [hoover] to that little space, but I realise it’s really hard to [access the area], so I give up!” (P19).

The markers are only the first step of a sequence. Up to three behaviours were coded after each breach, which gives a sequence of behaviours at each joint. Table 1 lists the ten most frequent sequences (Oraee, 2024, pp. 128–133). The most frequent begins with a scan, identifies possibilities and continues the activity; a decision was reported for these breaches. Several sequences involve no decision: a minor shift followed by a return to the task, a retry followed by continuation, or a complete shift to another activity.

Table 1 Ten most frequent sequences of behaviour at a breach

Sequence	Occurrences
Scan → identify possibilities → continue (decision reported)	626
Hesitation → identify possibilities → continue (decision reported)	232
Shift → continue (no decision reported)	200
Hesitation → scan → identify possibilities → continue (decision reported)	191

Sequence	Occurrences
Scan → identify possibilities → activity initiation (decision reported)	180
Retry → continue (no decision reported)	131
Shift (no further behaviour coded) (no decision reported)	114
Pause → scan → create possibilities → continue (decision reported)	106
Scan → identify possibilities → continue (no decision reported)	81
Shift (decision reported)	70

Note. From Oraee (2024, pp. 128–133), recounted on the final dataset (the thesis gives 132 and 82 for rows 6 and 9). Arrows show the coded behavioural order; decision status in parentheses applies to the whole breach and does not locate the decision within the sequence.

4.2 Breaches and decisions

We identified 3,212 breaches, about one every 65 seconds, or 55 an hour. Participants experienced 2,436 of them (75.8%) as decisions, about one every 86 seconds, or about 42 an hour, with each participant experiencing an average of about 41 micro-decisions in the recorded activity. The other 776 breaches (24.2%), about 13 an hour, were handled without any experience of choice. For example, a participant moved a bin out of the way to vacuum: “I have to move it because I can’t vacuum [otherwise]. So, it’s kind of… yeah, it’s part of my flow state, it’s not an active decision” (P48). Counting each breach once, 399 of these 776 involved a shift or give up, 181 began with retry, and 170 involved continuation without these codes, usually after a scan (115). The remaining 26 followed other paths. Breaches with an initial retry marker are counted as retries, even if they also contain a shift or give up.

These non-decisional breaches are not noise. They include automatic corrections, reactive responses to external events and forced transitions, which participants did not experience as choices. Treating all breaches as decisions, as broad conceptions of choice might suggest, would mischaracterise one breach in four. “Decision” rates varied between

participants, from 48% to 100% (mean 76.5%). Across four equal time quarters of each clip, the proportions were 77.1%, 76.4%, 74.8% and 75.0%.

Self-initiated breaches made up 49.2% of the 3,116 breaches whose source could be coded. A breach was coded “self-initiated” when the person (and not the environment) generated the shift of attention or activity. It was coded “external” when an event in the environment triggered it, such as a noise, another person or a falling object. Self-initiated breaches were experienced as decisions more often than external ones: 1,300 of 1,533 (84.8%) against 1,119 of 1,583 (70.7%). The difference is significant (odds ratio 2.31, 95% CI 1.75–3.06, $p < .001$, with standard errors clustered by participant).

The markers fell into two groups. Breaches with a pause, a hesitation or a scan, and no retry or give up, were experienced as decisions in 91.9% of cases (2,211 of 2,407). Breaches with a retry or a give up, and none of the other three markers, were experienced as decisions in 16.7% of cases (44 of 263). Breaches without an initial marker, most of them with a shift as the first following behaviour, were decisional in 33.3% of cases. Scanning was the most frequent marker in nine of the ten activity types. The frequent scanning is consistent with a *situated exploration* of the environment during micro-decisions (Suchman, 1987). Table 2 shows each behaviour as first response (the marker) and anywhere in the breach, counted once per breach. For four behaviours the two counts give nearly the same decision rate; give up rises from 31.0% to 53.3%, because later give-ups mostly follow a pause, hesitation or scan.

The contrast remained when we used FH’s and NL’s own final marker and decision codes on the matched breaches: 69.5% versus 27.5% for FH and 84.6% versus 25.6% for NL. It also remained among the 51 RRIW participants (91.4% versus 16.5%) and within 47 of the 49 participants with breaches in both groups. The two exceptions each had only one breach in the retry/give-up group. Breaches with an initial Give up marker were more often decisional than non-decisional in these small coder samples, including the first author’s codes for the same breaches (Online Resource 2).

Table 2 Behavioural markers and decision experience (3,212 breaches)

Marker	First response (n)	Decision (%)	Anywhere in the breach (n)	Decision (%)
Pause	431	97.4	485	96.7
Hesitation	766	94.5	826	94.1
Scan	1,223	88.2	1,833	89.1
Retry	213	15.0	219	16.0
Give up	58	31.0	135	53.3
No marker	541	33.3	–	–
All breaches	3,212	75.8	3,212	75.8

Note. A breach can carry more than one marker (20 breaches carried two). First response: the behaviour was the first response to the breach (the marker). Anywhere: the behaviour occurred at any point in the breach, counted once per breach; for give up, this includes the code Abandon (Appendix A). Decision: percentage of these breaches experienced as a decision.

The pauses were short. Their duration was recorded for 420 of the 431 pauses (median 3 s, mean 4.4 s, range 1–30 s). Longer pauses were not more often decisional: across four duration bands (1–2, 3, 4–5 and 6–30 s), decision rates were 97.7%, 97.7%, 99.0% and 97.0%. Almost all pauses were decisional in each duration band.

Decision rates also varied across activities. Among the seven activities with at least 78 breaches, they ranged from 67.8% for commuting and for eating and drinking to 82.6% for rearranging the room. Activities in which the environment seems to offer many options, such as rearranging, had higher rates than activities more governed by external constraints, such as commuting. The number of options was not measured, however.

4.3 The micro-decision sequence

Later behaviours (after the first response to the breach) differed between decisional and non-decisional breaches (Table 3). Identifying possibilities was coded in 65.7% of decisional breaches and 21.0% of non-decisional breaches. Creating possibilities was coded in 319 decisional breaches (13.1%) and only six non-decisional breaches (0.8%). A shift to another activity was coded in 51.4% of non-decisional breaches and 18.7% of decisional breaches.

These accounts describe the subject in task-solving mode. The subject acquires information on the affordances at hand, mostly by scanning the environment, builds and considers alternatives, possibly hesitates, and initiates action.

In the routine activities we observed, most joints are not problematic: the activity continued after about 70% of breaches, whether they were decisions or not (70.1% and 70.9%).

Table 3 What came after the first response, in decisional and non-decisional breaches.

Later behaviour	Breaches experienced as decisions (N = 2,436), n (%)	Breaches not experienced as decisions (N = 776), n (%)
Activity		
Continue	1,708 (70.1)	550 (70.9)
Shift	456 (18.7)	399 (51.4)
Activity initiation	347 (14.2)	25 (3.2)
Activity extinction	49 (2.0)	5 (0.6)
Problem solving		
Identify possibilities	1,600 (65.7)	163 (21.0)
Create possibilities	319 (13.1)	6 (0.8)

Later behaviour	Breaches experienced as decisions (N = 2,436), n (%)	Breaches not experienced as decisions (N = 776), n (%)
Markers again, later in the sequence		
Scan	580 (23.8)	58 (7.5)
Give up	65 (2.7)	41 (5.3)
Hesitation	59 (2.4)	7 (0.9)
Pause	56 (2.3)	5 (0.6)
Retry	7 (0.3)	25 (3.2)

Note. Each breach was coded as a sequence: a first response (Table 2), then up to three later behaviours (this table), for example scan → identify possibilities → continue. Percentages are of breaches: a behaviour that appears twice in a breach is counted once, and a breach can appear in several rows. Give up includes the code Abandon (Appendix A).

For example, the bin liner episode shows pause → scan → create possibilities → continue, with a decision reported for the breach (Table 1). Pulling the strings of a full bin bag, a participant tore it, and stopped: “I pause for like, how long was it? It felt like 20 seconds or so, but I’m actually deciding what to do, and then I kind of decide what needs to be done. Like, it’s a bit hard to explain, but when I’m pausing, I’m trying to, like, visualise, and it’s definitely that I need to use another [bin] liner, right? But then I’m scanning for the potential solution I thought of and to, like, materialise the solution and make it happen” (P42).

The participant had never met this problem before, and has often used two liners since. Pause, simulation, scan and the creation of a possibility followed each other, and led to a new way of finishing the task: a second liner in place.

Identifying a possibility can be quicker, and need not involve a decision. The thesis classifies the following example as scan → identify possibilities → continue, without a micro-decision (Oraee, 2024, p. 132). A participant who needed to unblock a sink explained: “I

needed something sharper to fit in the sinkhole. I was scanning to see what I use, and the knife in the dishwasher looked like it would fit and do the job" (P15).

The environment can also suggest a new subgoal. In a supermarket aisle, a participant saw a vegan sauce: "I didn't think from before that I needed that sauce, but I just saw it and why not?" (P24).

In some of these examples, a decision goes with the setting of a new subgoal. A change of subgoal is not always experienced as a decision, however. For example, a participant chopping vegetables realised that the rice cooker had to be started, started it, and went back to the vegetables, without reporting a decision (P40).

4.4 Sequences without a decision: retry and moving on

Retry was coded as the initial response in 213 breaches; each counts as one retry episode, whatever the number of attempts. Only 15.0% of these episodes were experienced as decisions. Counting the first attempt, the 213 episodes totalled 843 attempts (median 2, mean 3.96, range 2–63). The outcome was recorded for 211 episodes, and retry succeeded in 148 (70.1%).

After a successful retry, continuation was the next coded behaviour in 99% of cases, and 9.5% of these episodes involved a micro-decision. After a failed retry (63 episodes), 28.6% involved a micro-decision. The next behaviour was a shift to another activity (27%), another retry (24%), a give up (24%) or identifying possibilities (11%). A typical retry is described without any reference to choice:

"I scanned [swiped] my card because the department door only opens like that, but then the door didn't open, so I pushed again." Asked whether this was something experienced as having to decide over: "Um… no, I think it was automatic, or because I use this door every day, I know how it works" (P23).

To an observer, a series of retries looks at first sight like conscious, deliberate behaviour. Participants did not experience it so: 85% of retry episodes were not experienced as decisions. The following account describes reassessment after failed retries:

“I tried to open the drawer, but it wouldn’t budge. I knew it should open – I know how these things work. I just tried again and put a bit more force into it. It still didn’t work, so I reckoned there is something behind it, blocking the drawer” (P1).

When a retry and a give-up occurred in the same breach, the episode was experienced as a decision in 7 of 24 cases (29.2%). This is more than for retries without a give up (25 of 189, 13.2%), but the numbers are small. For example, a participant tried several times to open the locked door of a washing machine, then switched the machine off and on again: “It didn’t work. So, I made a decision to power it off completely” (P19; Fig. 1). Here, the participant reported deciding to change the approach. Decision reports did not become more frequent with more attempts. Episodes of two attempts were decisional in 18.5% of cases (23 of 124), of three or four in 12.2% (6 of 49), of five to nine in 9.7% (3 of 31), and none of the nine episodes of ten or more attempts was. These counts do not locate the decision within the retry sequence. The numbers are small, and this deserves further study.



Fig. 1 Retry followed by a change of approach. A participant tries to open the locked door of a washing machine, retries twice, then switches the machine off and on again (P19). Snapshots and replay comments adapted from Oraee (2024, Fig. 14, p. 91). Times are rounded to the nearest second.

We call “moving on” leaving the current line of action before its goal is reached. This umbrella category covers abandonment, avoidance, leaving without any decision felt, diversion by an external event, parking, and accounts that do not tell. Here we examine breaches coded Give up or Abandon. Give up occurred in 135 breaches: as the first response in 58, and only later in the sequence in 77. It took us a while to understand that the same observed behaviour covers different processes; detailed analysis of the replay interviews elucidated them. In 72 of these breaches (53%), participants reported a decision; in 63 (47%), they did not. These are the two counts the codes provide. The replay accounts show that moving on takes several forms. They differ by whether a decision is reported, by what is left, and by what becomes of the subgoal. Some accounts with a decision describe abandonment: the subject decides to give up what they were trying to do right now. For example, a participant gave up preparing a meal and took leftovers: “But then I realised it’ll take at least half an hour, probably more, so I just gave up and took some leftovers”. Asked whether this was experienced as making a decision, the participant replied: “Yeah, definitely!” (P17). The goal of eating was kept; only the path changed.

Without a decision, the accounts describe different things. Some describe avoidance: the person senses that a choice is needed and declines to engage. For example, a participant who had struggled with a faulty drawer “just left it as it was”: “It wasn’t really a decision; I was just trying to avoid having to deal with it” (P41). In avoidance (spotted from the RIW analysis), the subject gives up the process of decision-making itself. Other accounts do not say whether a choice was felt and declined, or whether no choice was felt at all. In the hoovering example below, P19 “didn’t consider” and was tired; the thesis classifies this case as avoidance (Oraee, 2024). Other accounts again follow an external event that captures the

person, as with the phone call below (P37). This is diversion rather than giving up. Avoidance is not separately labelled in the final worksheet, and the codes cannot separate these cases, so we do not report their frequencies.

The subgoal that is left may be dropped or parked for later, with or without a decision. P33 left the groceries on the counter and returned to them that evening; P40 left the dishes “for later”; P41 left the drawer “for another time” (Oraee, 2024). Parking leaves a task open for later resumption, as studied by Ovsiankina (1928) and discussed below. Two further cases are close to moving on. In satisficing, the tolerance of the goal moves, and the activity carries on with a lesser result, as with the participant who could not fit all the books on a shelf (P53). In some breaches, finally, the account does not tell what happened. P15, below, does not “recall like, deciding”, which expresses uncertain recall more than a denial of deciding.

Decision reports varied with what came before the give up. When give up was the first response to the breach, they occurred in 18 of 58 cases (31%). After a retry, they occurred in two of 17; after a pause, a hesitation or a scan, in 43 of 46; in the 14 other cases, in nine. What followed the give up also varied. The participant shifted to another activity in 49 breaches (24 with a decision report) and continued the activity in 35 (13 with a decision report); six breaches contained both. No different behaviour was coded afterwards in 52 breaches (34 with a decision report), and other behaviours followed in five (two with a decision report).

What is left can be the subgoal or the whole activity. The subject may switch to another activity. A tired participant left the booking of a train ticket and scrolled on Facebook instead: “I don’t actually recall like, deciding over this” (P15). A shift can also follow an external event: a participant unloading the dishwasher heard an awaited phone call, left the kitchen, and forgot the dishwasher (P37).

The subject may also hop over a subgoal and go on with the activity. After three attempts to reach a corner with the hoover, a participant moved to another area and went on cleaning. Asked whether this was a decision, she replied: “No, I didn’t consider. I don’t think it was a decision” (P19). Another participant described leaving the dishes for later while

continuing cleaning: “I didn’t decide to quit cleaning, but it’s just that the dishes can be organised later […] so I just leave that for later and um…I skip that certain task [putting the dishes back]” (P40). A hop over can also be decided. Searching for a snack that was not there, a participant “just decided to take something else” (P22).

4.5 The flowchart

To sum up, the activity proceeds from subgoal to subgoal. About once a minute, the flow breaks. About half of the breaches are self-initiated. A minority of breaches (6.6%) lead to a retry, sometimes repeated (median two attempts, up to 63). Retries succeed in 70% of the episodes, and the activity then continues, mostly without a decision. When retries fail, or when the subject does not retry, the subject may re-evaluate the situation. The subject may then make a micro-decision, reported in 97% of breaches with pauses, 95% with hesitations and 88% with scans. Or the subject may “move on” without deciding; avoidance is one possibility.

A decision may lead to a new plan, with which the activity continues, or to the abandonment of the activity. When the final goal is reached, the activity ends.

Fig. 2 summarises these trajectories. The arrows show a proposed process; the numbers summarise coded breaches. It is adapted from Oraee (2024, Fig. 35, p. 224).

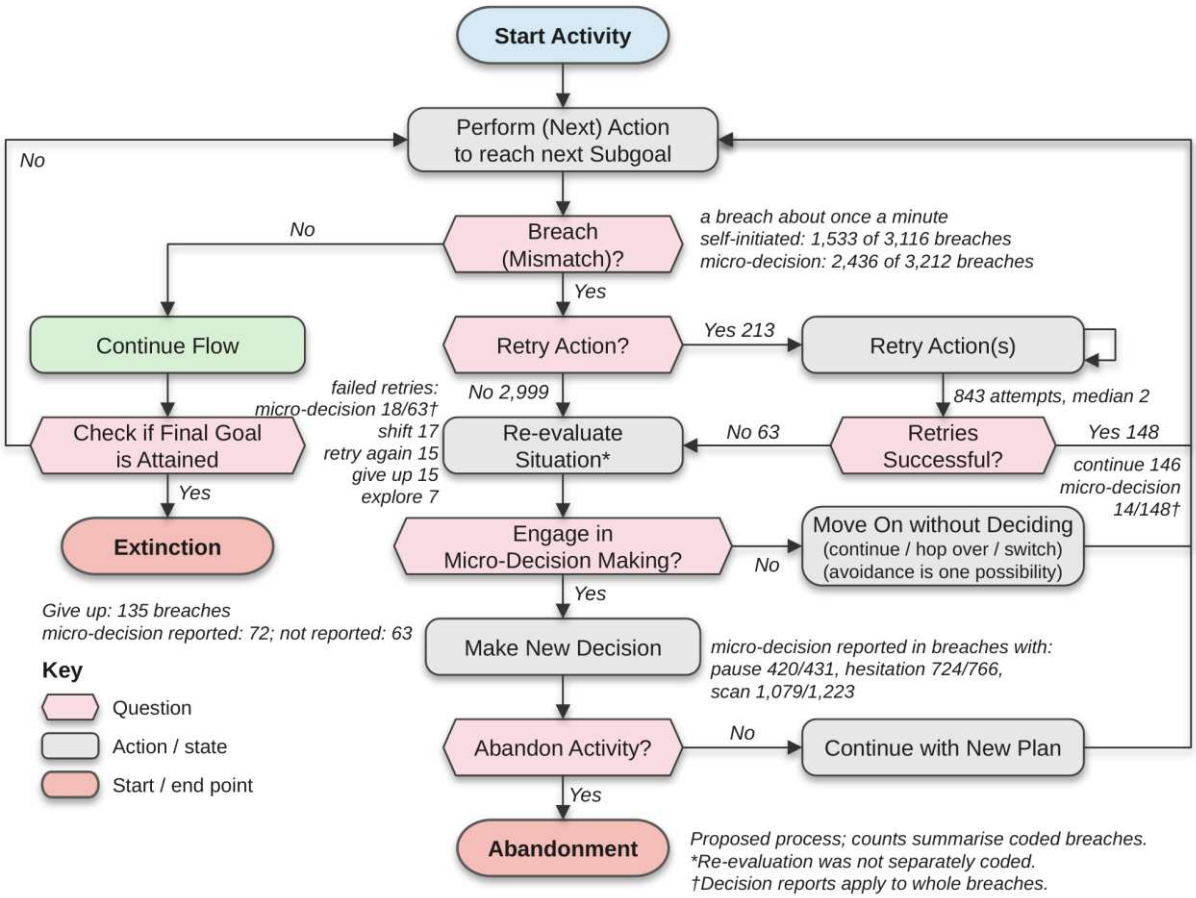


Fig. 2 Proposed micro-decision process, adapted from Oraee (2024, Fig. 35, p. 224), with counts from 3,212 breaches in 60 participants. Arrows represent proposed relationships rather than measured transitions. *Re-evaluation was not separately coded. †Decision reports concern whole breaches; their timing within the sequence was not coded. Two retry outcomes were unknown. The later-behaviour counts shown are selected: nine failed-retry episodes had other or no later behaviours; in two successful-retry episodes, Retry preceded Continue

5 The model

The flowchart brings these trajectories together. We now propose a model of the mechanism that produces these trajectories. Each of its elements rests on known processes,

but our material, which shows only behaviour and experience, does not establish the mechanism as a whole. It should be read as a hypothesis.

5.1 Activity as a perception–action spiral

Activity runs as a perception–action spiral. Uexküll (1928) described the functional circle through which an animal perceives its world and acts on it. Neisser (1976) described perception as a cycle: anticipatory schemata direct exploration, exploration samples the information available in the environment, and this information modifies the schemata, which then direct further exploration. Each action changes the situation, which is perceived anew and feeds the next action.

Two processes run in parallel. A feed-forward prepares what to do next, on the way to the next subgoal. It answers the question that every animal faces continuously in the course of activity: “now what?” (Lahlou, 2024). Rubinstein placed the same question at the origin of thinking: life itself confronts a person with the question of what to do (Rubinstein, 1958/2021). Feedback from the senses reports how the situation actually unfolds.

5.2 A mismatch halts the action

Feed-forward and feedback are compared continuously. Small differences are absorbed within the action. The motor command is adjusted to the local circumstances, partly before the movement and partly during it, nearly immediately, in a way that depends on the goal, as shown by experiments on speech with a bite block or a perturbed jaw (Kelso et al., 1984; Lindblom et al., 1979). The hand adjusts its grip, the foot its step, and the activity continues. For example, we push harder on a heavy door, within the same movement.

A breach occurs when such compensation can no longer bring the outcome within what is good enough for the goal. Repeating the movement is then already a response to the breach: a retry.

A mismatch, here a prediction error in the motor sense, triggers a breach when the difference between feed-forward and feedback goes beyond what pattern recognition can tolerate and online motor adjustment can absorb, given the tolerance of the goal. The mismatch flags a problem and interrupts the action. The flow breaks. For example, we send a print order and expect to get up and collect the printout. But the printer noise does not come. So, we do not get up: instead, we try to work out what happened, or, more often, we first send the print order again. Similarly, we push a door we expect to open, and find it locked: our first move may be to push again, and if it still does not open we re-evaluate the situation. In both cases the current subgoal cannot be reached.

Breaches can also come from inside, when the subgoal itself changes. Here the mismatch is between the current action and the new subgoal:

“I was about to eat, but then I remembered I had an urgent email to send to this woman that I call every day for charity purposes. I thought to send the email first before sitting down to eat, which is why I left it [food] on the table and went to my computer. […] Yes, it was a decision for sure” (P29).

We propose to treat external and internal breaches as two forms of mismatch. For external breaches, the mismatch can be a prediction error in the usual sense. For internal breaches, it is not strictly a prediction error: the current action conflicts with a revised goal or priority. In both cases, our mind and body suggest we are on the wrong path to get satisfaction.

The threshold for such a mismatch to trigger a breach is functional: it depends on the size of the difference, the compensation available and the tolerance of the goal. This tolerance can itself move. For example, a participant who could not fit all the books on a shelf accepted a lesser result and carried on (P53). This is “satisficing” (Simon, 1956) at the scale of seconds. Memory access can also reveal the mismatch: “I couldn’t remember if I needed to add the herbs before or after simmering. Yeah, I paused for a moment; it’s a pause; I’m trying to remember the last time I cooked it” (P54).

What defines “good enough”? Like “how long is a piece of string?”, the question has no general answer: it depends on the goal and the situation. It is an empirical question, as with satisficing. In our material, good enough is inferred from what the subject accepts: the point where correction stops and the activity carries on, as with the bookshelf (P53) or the cleaning that “feels like it’s clean enough” (P1, exploratory study). How the tolerance is set, and how it moves, is a question for neuroscience, probably a research programme in itself. We did not measure this tolerance independently.

5.3 Escalation by subsidiarity

We propose that, once the flow is halted, a cascade can occur, to answer “now what?” It follows the principle of subsidiarity: more extensive control is recruited when simpler responses are insufficient. The subject may also re-evaluate directly, without retrying.

At a first level, the unsuccessful action is repeated: this is retry, the simplest form of problem solving. We propose that many retries preserve the current course without setting a new subgoal. Most retries were not experienced as decisions (85%). The 32 breaches with decision reports show, however, that retry and experienced deciding can occur in the same episode. In our material, retry was not the most frequent move, but when attempted it succeeded in 70% of the episodes.

If retry fails, or if the subject does not retry, attention to sensory input may increase (Corbetta et al., 2008; Feldman & Friston, 2010). Pausing, scanning and hesitating are possible *signs* of re-evaluation. Scanning resembles the orienting-investigative reaction that follows a mismatch in Anokhin’s scheme (Sudakov & Zilov, 1975). At the next level, the subject simulates possible actions with the affordances at hand and compares the simulated outcome with the goal. Memory feeds this simulation, as when a participant hesitated while trying to remember whether the dish was already salted (P27, above). Gibson rejected inference and memory as the basis of perception (Gibson, 1979). We keep his account for the flow and depart from it at the breach.

Further levels recruit external resources. For example, one participant checked a recipe (P54), another searched the web after retrying in vain (P52), and a third asked her housemate how to open the washing machine (P19).

Re-evaluation does not necessarily lead to a decision. Pausing, hesitating and scanning are associated with decision reports, but also occur without them. When the subject engages in micro-decision making, its course resembles a simplified decision process: the subject acquires information, evaluates it against goals (and likely against values), then chooses a path and acts. Our criterion for a decision is that the subject labels it as such, in the course of the re-enactment triggered by the replay interview.

The rationale of this organisation seems to be as fast and frugal as possible, and to mobilise only the resources needed, which makes sense in an evolutionary perspective of efficiency. Many breaches are absorbed at the lowest levels. Decision is reserved for the cases where a good subgoal is not provided by the flow. This fits the idea of frugal heuristics adapted to their environment (Gigerenzer et al., 1999).

Neuroscience offers a possible account of this organisation, based on laboratory evidence. In terms of the cascade model, a retry may preserve the current task set. Conflict-monitoring accounts allow increased control when responses compete (Botvinick et al., 2001). In hierarchical predictive processing, local adjustments can occur while higher-level goals remain stable (Pezzulo et al., 2018). At re-evaluation, additional contextual or episodic control may be recruited (Koechlin & Summerfield, 2007). In this reading, pausing may allow reconsideration, scanning gathers information on possibilities for action, and hesitation may reflect competition between responses. Identifying possibilities may resemble switching to a strategy already held in memory, and creating possibilities may resemble creating a new one (Collins & Koechlin, 2012; Donoso et al., 2014).

5.4 Outcomes: continue, hop over, switch

The evaluation ends in one of three outcomes for the trajectory. The subject may continue the current activity, after minor problem solving or a micro-decision. The subject

may also move on, in two ways. The first is to hop over the current subgoal and branch to a later point of the trajectory, as when a participant left a hard-to-reach corner and went on cleaning (P19). The second is to switch to another activity, as when a participant left the meal on the table to send an email (P29).

Whether a decision is experienced is a second dimension, distinct from the outcome (Table 4). Each outcome can occur with or without a decision. Abandonment, avoidance and diversion describe different accounts of moving on. None is a separate route in the trajectory, and a nondecision report alone does not establish avoidance.

A subgoal that is left is not always lost. Some are picked up later, as Ovsiankina (1928) observed for interrupted tasks: the participant who left groceries on the counter to eat and rest reported returning that evening, also describing this as a decision (P33).

Table 4 Outcome of the trajectory and experience of a decision, with examples

Outcome	Not experienced as a decision	Experienced as a decision
Continue the current activity	P23 pushes the door again	P27 adds a little salt after hesitating; P42 uses a second bin liner
Hop over the current subgoal	P19 leaves a hard-to-reach corner while hoovering	P22 takes another snack; P17 eats leftovers instead of cooking
Switch to another activity	P15 leaves the train booking for Facebook, without recalling a decision	P29 leaves the meal for an urgent email; P33 leaves the groceries on the counter to eat and rest

Note. P15 follows the thesis's avoidance classification (Oraee, 2024); the response expresses uncertain recall rather than an explicit denial of deciding.

5.5 When decisions occur

The model locates decisions at the joints of activity. A mismatch halts the flow: this is the breach. A decision occurs when a good subgoal is not provided by the flow and has to be set by the actor. It addresses the mismatches that the subject evaluates as requiring a reset of the task. In practice, the reset can set a new goal, as when a participant left the meal to send an urgent email (P29), or reinstate the same goal with a different path, as when the participant whose bin liner tore used a second liner (P42). A good subgoal is one the actor accepts as workable in the situation. At the reset, the direction of the evaluation changes. In the flow, the goal is taken as given, and the situation is evaluated against it. At the reset, the current situation is taken as given, and the quality of the subgoal is evaluated against it. Walking is an example. Every step is a potential pivot, but we pivot only when we feel that the trajectory must change. Comparison runs at every step, without any experience of it; re-evaluation occurs only when a mismatch is felt. A decision may also occur at an open transition, when an activity has ended and the next one is not yet set. Some participants described following given subgoals, for example instructions, without deciding; they are "acting on a set of pre-decided tasks" (P12). When the final goal is reached, the motive is satisfied and the subject moves to another activity. Whether the goal is reached is judged against its tolerance: "I'm pretty sure I go back and forth as well until the overall situation is like 'okay, this feels like it's clean enough'" (P1, exploratory study, cleaning).

Reaching the expected end of an activity need not be experienced as a further decision (Oraee, 2024, p. 203). In this account, once the outcome is good enough, no further correction is needed.

The whole process rests on one operation, comparison, and one principle, subsidiarity. An error is handled at the lowest level that can absorb it, and only the residue escalates. The movement absorbs small errors, retry handles failed movements, and re-evaluation and decision handle what remains.

6 Discussion

We studied one type of situation: breaches in the flow of everyday activity. The model draws on several traditions. Table 5 summarises, for each step of the model, what each tradition says about it. We comment on each row, then on what our material brings to each tradition.

Table 5 One principle across traditions: the steps of the model and their counterparts

Step of the model	Psychology of activity	Physiology of action	Human performance	Neuroscience of control	Decision science
Flow	Operations run; the next subgoal is given by the installation (Lahlou, 2017; Leontiev, 1978)	Result matches the acceptor of action results (Anokhin, 1974)	Skill-based behaviour (Rasmussen, 1983)	Lower levels select the action (Koechlin et al., 2003)	No choice point
Absorption within the action	Operations adjust to the conditions; the action is unchanged (Leontiev, 1978)	On-the-fly sensory corrections (Bernstein, 1967; Kelso et al., 1984)	Skill-based behaviour	Sensorimotor control	Not addressed
Retry	The operation is repeated	The test–operate loop is repeated (Miller et al., 1960)	Not distinguished	Strategy kept; no change of task set required	Not addressed
Re-evaluation	The operation becomes an action again (Leontiev, 1978)	Mismatch triggers an orienting-investigative reaction and a new afferent synthesis (Sudakov & Zilov, 1975)	Attentional check detects a problem (Reason, 1990)	Conflict monitoring raises control (Botvinick et al., 2001)	Information search; recognition (Klein, 1993)

Step of the model	Psychology of activity	Physiology of action	Human performance	Neuroscience of control	Decision science
Decision	Setting the next subgoal; “dramatic rehearsal” (Dewey, 1922)	Change of the model of the required future (Bernstein, 1967)	Rule-based (stored rule) or knowledge-based (new solution)	Switch to a stored strategy or create a new one (Collins & Koechlin, 2012)	Choice; satisficing (Simon, 1956)
Avoidance	Quasi-need left open; later resumption of parked tasks (Ovsiankina, 1928)	Not addressed	Not addressed	Not addressed	Decision avoidance (Anderson, 2003; Janis & Mann, 1977)

Note. The mapping proposes correspondences between different levels of description. It does not establish that they are the same process. Parked tasks can occur with or without avoidance. The physiological and neural columns rest on laboratory work; our material shows behaviour and experience only.

6.1 Each principle across traditions

Flow. Several traditions describe a flow that can run without an experienced choice as long as results match expectations. Activity theory calls it operations; Anokhin, a match with the acceptor of action results; Rasmussen, skill-based behaviour; the cascade model, the selection of actions at the lowest level. The decision theories reviewed here begin at the choice point. Installation Theory adds why the flow usually runs: the setting gives the next step.

Absorption within the action. Small differences are absorbed within the action. Leontiev’s operations, which adapt to the conditions while the action is unchanged, and Bernstein’s background corrections describe this level. Studies of speech show it at work

almost immediately (Kelso et al., 1984; Lindblom et al., 1979). By definition it is invisible in our material, except when it fails.

Retry. Here our material departs from the frameworks. Retry is a distinct path, rarely experienced as a decision, which succeeds in most cases. The test–operate loop allows it, since the test is simply repeated. Rasmussen's levels do not distinguish it, and the decision theories reviewed here do not distinguish it.

Re-evaluation. All traditions describe an increase of control when a problem is detected: an operation becomes an action again, a new afferent synthesis begins, an attentional check fires, conflict monitoring raises control. We interpret pauses, scans and hesitations as possible signs of this re-evaluation.

Decision. The traditions converge on the setting of a new course of action: a new subgoal, a new model of the required future, a stored rule or a new solution, a stored or a new strategy. Our material adds the person's experience: a decision is what the subject designates as such, and in some accounts it goes with the setting of a new subgoal.

Avoidance. Avoidance is the least addressed step. Decision science documents it with options set up by the experimenter (Anderson, 2003). Ovsiankina's resumption of interrupted tasks covers the subgoals that are parked; the Zeigarnik effect (Zeigarnik, 1927) concerns recall of interrupted tasks. Some replay accounts suggest avoidance after breaches that nobody set up, including avoidance of the decision-making process itself. Procrastination, a phenomenon observed on "big decisions", appears similar to these accounts of "avoidance" at the micro scale; that is food for thought.

More generally, the pattern we observe at the micro scale seems analogous to what is observed at larger scales. Theories and narratives of rupture share the same sequence: a steady state, a breach, a crisis, then resolution or transformation (Gillespie & Zittoun, 2025). In the Trajectory Equifinality Model, a person's orientation usually leads to the next goal; when an obstacle appears, a bifurcation point calls for a decision (Sato et al., 2009, p. 234). Rasmussen's (1983) model of skill-, rule- and knowledge-based behaviour describes a similar escalation in work settings: when skill-based behaviour meets a problem, the operator

looks for a stored rule, and turns to knowledge-based reasoning only when no rule fits (Reason, 1990). Breaches in the flow of daily activity may be the shortest time scale of such ruptures, and micro-decisions the smallest bifurcation points. In our reading, all these patterns express the same idea: activity moves forward with the most frugal strategy available, and escalates only when it fails, much as people look for “the minimum viable change” (Gillespie & Zittoun, 2025, p. 3).

6.2 What the material brings to each tradition

Activity theory and Installation Theory. Our material agrees with the distinction between actions and operations, and locates decisions at the joints of activity. It adds a candidate behavioural sign of an operation becoming an action again: the breach. Overall, the reliance of the subjects on the environment, and the fact that most orientations at the joints involve only micro-decisions, fit situated action and Installation Theory. The societal environment, with its affordances, social regulation and the embodied competences to interpret them, has been designed precisely to make the course of daily activity predictable and fluid, so that it requires only minor adjustments (Lahlou, 2017, 2024).

Physiology of action and comparison loops. Our material agrees with the loop of anticipation, comparison and correction described by Bernstein, Anokhin and control theory (Carver & Scheier, 1998; Powers, 1973), and with predictive accounts of behaviour (Clark, 2013). These accounts concern action or perception. Our material adds observations of breaches in everyday activity, and of when they are experienced as decisions.

Human performance. The levels of control described by Rasmussen (1983) and Reason (1990), and the supervisory control of Norman and Shallice (1986), show the same subsidiarity that appears in our model. Our model adds four things to this framework. It is based on observation in everyday settings, breach by breach. It uses the participant’s own account of whether a decision occurred. It identifies retry as a distinct behavioural path. And it includes the possibility that the subject avoids the decision altogether.

Neuroscience of control. The subsidiarity of our model resembles the hierarchy proposed in the cascade model of cognitive control (Koechlin & Summerfield, 2007). A breach may be resolved within the current task set, or involve competition between strategies and recruit additional control. Decisions, experienced as choices between alternatives, would sit on this second side. The course of a micro-decision resembles what Collins and Koechlin (2012) describe in the laboratory: switching to a stored strategy, or creating a new one. The near-exclusive association between decisions and the creation of new possibilities in our material (319 of 2,436 decisional breaches against 6 of 776 nondecisional breaches) may be a naturalistic counterpart of their model's proposal that a new strategy is probed when none of the monitored strategies appears reliable.

Decision science. Here the differences are important, likely because decision science addresses different types of choices and uses different criteria for "decisions". Decision theory usually starts from a choice point where the options are given (von Neumann & Morgenstern, 1944; Savage, 1954). In our material, choice points were not set in advance, and one breach in four was not experienced as a decision. The empirical question is therefore when a change in ongoing activity is experienced as a decision. The recordings and replay accounts let us study this question breach by breach in ordinary tasks. Dual-process accounts distinguish fast, automatic processing from slow, controlled processing (Evans, 2008; Kahneman, 2011; Stanovich & West, 2000). Here, a decision is what participants experienced as one. Pauses were brief and mostly experienced as decisions, but pause duration is not a measure of decision time. We did not compare decision times across the different markers. Our model concerns whether a good subgoal is provided by the flow or has to be set by the actor.

Other findings of decision science agree with ours. People settle for what is good enough (Simon, 1956), as the participant with the crowded bookshelf did. Experts in naturalistic settings often recognise a workable option and act on it, without comparing alternatives (Klein, 1993). This corresponds to identifying possibilities in our model. Ecological rationality shows that simple heuristics exploit the structure of the environment

(Gigerenzer et al., 1999; Todd & Brighton, 2016). Our material adds that this structure is explored at the moment of the breach, mostly by scanning, close to Gibson's affordances and to the search image described by Uexküll (1928). Situated and distributed cognition place cognition in its material and social context (Hollan et al., 2000; Hutchins, 1995; Suchman, 1987). The predominance of scanning is consistent with micro-decisions being made with the environment as well as in the head. Finally, Camilleri (2023) mapped the top of the decision range: big life decisions, rare, contemplated and consequential. Micro-decisions are constant, brief and resolved within the flow of activity. Yet both are experienced as decisions, and in both the person sets a goal that the situation did not give. The difference is one of degree, in the importance of the goal and in the resources invested.

6.3 Other situations

Our material covers one boundary only, between the autopilot and the micro-decision. It shows a few steps beyond, when memory and external sources were recruited, as with the recipe (P54) and the web search (P52). In our mapping of the choice situation (high vs low importance, more or less situated in the material environment) other regimes are a proposal.

Classic decision-making may involve building a problem space when a workable course is not already available (Newell & Simon, 1972). Expertise in the situation might rest on the same subsidiarity, with a much deeper stock of stored strategies installed by training. In the terms of Installation Theory, training installs competences in the actor (Lahlou, 2017). The expert firefighter recognises the type of fire and acts on the first workable option (Klein et al., 1986). This is close to what our participants did when they identified a possibility.

The limits between regimes are blurry, and one episode can cross them within seconds. In the bin liner episode, the participant paused, was "trying to visualise" a solution, then scanned the kitchen to find what was needed (P42). Mental simulation and exploration of the environment ran together. Several mechanisms are probably at work in every regime; what changes is which one dominates. This view may lead to a different formulation of the dual model of System 1 and System 2 (Kahneman, 2011). The regimes would be defined less by

the speed of processing than by where the problem is solved, in the environment or in the head, and by the level of control that the situation requires.

6.4 Practical implications

Interventions at the point of choice could be tested at moments experienced as choices between alternatives. Their effects may depend on where breaches occur and how they are resolved. The model suggests testing whether obstacles prompt retries and whether opportunities to scan or reconsider alter decision reports. Designing installations therefore means deciding where the flow should run without decision, and where it should break.

6.5 Limits and open questions

The material illustrates the model; it also built it. The mismatch mechanism is a hypothesis consistent with our findings, but the data do not establish it (Oraee, 2024). The neuroscientific accounts we draw on rest on laboratory evidence, mostly imaging and modelling. Decisional status rests on participants' retrospective accounts, and participants may have understood "decision" in different ways. Recall and demand effects cannot be excluded. The markers and the decisional status both draw on the replay interview, so they are not fully independent. The additional coder comparisons use matched final records; they do not establish that all breaches were detected. The proposed link between a task reset and a decision report was not tested independently; a change of subgoal can also occur without a reported decision, as in P40. Breaches include open transitions as well as interruptions; the main results hold when the likely transitions are removed (Appendix A). Some categories rest on small numbers, such as give-ups (135) and failed retries (63). The outcomes "hop over" and "switch" were not coded as such; their examples are our reading of the participants' accounts.

The sample comes from one national recruitment context, a limit shared with most psychological research (Sears, 1986). Our participants were adults from the general population rather than students, but they all lived in the UK. The activities recorded were

mostly domestic and routine; professional work, social interaction and high-stakes settings were not systematically sampled. SEBE is resource-intensive, which limits sample size; automated coding of pauses, scans and hesitations from first-person video could allow larger studies. Several questions remain open, for example: what triggers a re-evaluation rather than a retry? Can re-evaluation and decision be distinguished in the brain? Do subjects differ in their criteria for calling an experience a decision? The field of Micro Decision Making is still in its infancy.

7 Conclusion

In daily tasks, activity runs as a semi-automatic flow, channelled by the setting. We studied 3,212 breaches in this flow, recorded with first-person cameras in the everyday activities of 60 people. The flow broke about 55 times an hour. People handled about 42 of these breaches with a small decision. They handled the other 13 or so without deciding: about 7 by moving on, 3 by simply trying again, and 3 by carrying on, usually after a quick look around. Overall, seven retries in ten succeeded. We summarised the observed trajectories and proposed how retry, re-evaluation, decision and moving on may be related.

The study makes four contributions. First, it measures micro-decisions breach by breach, in natural settings, with the person's own account of whether they decided. Second, it identifies initial behavioural markers associated with decision reports. In the main dataset, breaches with pause, hesitation or scan and no retry or give up were experienced as decisions in 91.9% of cases, compared with 16.7% for breaches with retry or give up and none of the other three markers. This contrast remained with both additional coders' final codes, within participants and among those who completed RRIW. These markers may help locate candidate micro-decisions for replay interviews and larger studies with automated coding of video. Third, it shows that micro-decisions are made with the environment. Scanning was the most frequent marker, and creating new possibilities occurred almost only in breaches experienced as decisions (319 against 6). Fourth, it proposes a model of the

mechanism, which connects research on motor control, human performance, the neuroscience of control and decision science.

The empirical finding is a systematic relationship between behavioural responses to breaches and the experience of deciding. The study provides recorded sequences, participants' accounts tied to those sequences, and reproducible comparisons through which theories of everyday action can be assessed.

We proposed a hypothesised mechanism. Activity is a perception–action spiral in which feed-forward and feedback are continuously compared. A mismatch between what we expect and what happens, if it cannot be absorbed within the action, halts it: this is the breach. An evaluation then escalates, level by level, to answer the question "now what?". The subject may rely on the simplest response, a retry, which works in most cases. If it fails, attention increases, possible actions are simulated, and memory or external resources may be recruited. The evaluation might also happen directly without retry, and ends by continuing the activity, hopping over a subgoal or switching to another activity, with or without a decision. A decision occurs when a good subgoal is not provided by the flow and has to be set by the actor. The task is then reset, towards a new goal or towards the same goal by another path.

The model rests on comparison and on subsidiarity. These principles are found in several traditions, from the physiology of action to the neuroscience of cognitive control, and our material is consistent with their operation in everyday life. Our material also provides naturalistic observations relevant to activity theory and functional-system physiology. The model places micro-decisions at the joints of activity, where the actor sets the next subgoal and so steers the course of the activity, answering so to the "now what?" question. In activity, as in walking, every step is a potential pivot, but we pivot only when we feel that the trajectory must change. This grounded model, which accounts for the behavioural flowchart we mapped, appears consistent with neuroscientific findings and makes sense phenomenologically. It now needs further investigation, and should at this stage be considered plausible but hypothetical.

8 Appendix A. Coding details and checks

8.1 Breaches and open transitions

Breaches include interruptions of an action and open transitions, where an activity has ended and the next one is not yet set (Oraee, 2024). As a check, we removed the 372 breaches followed by an activity initiation, which are likely open transitions. In the remaining 2,840 breaches, 73.6% were experienced as decisions (75.8% in the full set). The contrast between markers remained: 91.3% decisions for pause, hesitation or scan, against 16.8% for retry or give up.

8.2 Markers

Table A1 summarises the observable cues for each marker (Oraee, 2024). An observer can use them to propose a code. In the reinforced replay interview, participants coded themselves with cards: Pause, Hesitation, Scan, Retry, Give up, I do not know, and None. A participant could correct the researcher. For example, asked “Are you scanning?”, P55 replied: “No, I’m hesitating”. Twenty breaches carried two markers. In the 541 breaches without an initial marker, the initial label was None in 485 cases and I do not know in six; no label was selected in the remaining 50. No minimum duration was set for a pause: 30 pauses lasted one second. Online Resource 1 proposes explicit rules for a future replication; the present data were not recoded with them.

Table A1 Behavioural markers: observable cues and boundaries

Marker	Observable cue	Boundaries and context
Pause	The current movement stops or slows down markedly before activity proceeds.	Holding an object is not enough to show a stop. Waiting imposed by the task is noted as context. No minimum duration was set.
Hesitation	A movement that has started is checked, withdrawn, reversed or redirected. The person may alternate between approaches.	Describe the sequence of movements. Uncertainty and conflicting options are meanings reported by the participant. They are not visible on the video.
Scan	The head turns, or the person inspects places and objects, during a breach or an open transition.	Continuous monitoring that succeeds is excluded. A head camera does not record gaze, so a reported scan may not be visible.
Retry	The person makes another attempt at the same operation after a failed result.	Specify the operation and the failure. A renewed search counts. Routine repetitive movements and a clearly different means do not count.
Give up	The person stops pursuing a local task while it is still unresolved.	Identify the local goal and the stop. Distinguish from completion, waiting, external interruption and end of recording. Giving up need not be permanent.

Note. Cues from Oraee (2024). The final codes include the participant's view. The cues do not identify cognitive states.

8.3 Interviews and decisional status

All 60 participants had a standard replay interview within 12 days of the researcher receiving their recordings. Fifty-one subsequently had a reinforced replay interview. The decisional status comes from the reinforced interview for 51 participants (2,872 breaches), and from the standard interview for the other nine (340 breaches). When the participant had not already mentioned a decision, the researcher asked: “Did you experience this instance as making a decision?” (Oraee, 2024). The final dataset records binary decision/non-decision classifications and does not retain initial uncertainty as a separate field. The decisional status applies to the whole breach. It does not tell at which point of the sequence the decision occurred.

8.4 Independent coders

Two other researchers, FH and NL, applied the protocol to participants selected at random with an Excel formula. Each first located and coded the breaches in the footage, without seeing the first author’s codes, the participants’ accounts or each other’s codes. They then conducted RIW and RRIW themselves (Oraee, 2024). The final dataset keeps only their codes after the replay interviews. We matched their breaches with the main dataset on participant, clip and exact elapsed timestamp. We retained records with complete binary codes and at least one of the seven labels (the five markers, None or I do not know) recorded by each coder: 291 breaches from nine participants for FH and 300 breaches from eight participants for NL. Agreement on the full set of marker labels was 246 of 291 (84.5%; κ = .80) and 231 of 300 (77.0%; κ = .71). Agreement on decisional status alone was 264 of 291 (90.7%; κ = .81) and 267 of 300 (89.0%; κ = .75). Agreement on both the full set of marker labels and the decisional status was 78.4% and 71.7%. The two samples share 106 breaches and three participants, covering 485 different breaches from 14 participants in total. The thesis reports different figures for the same coders (85.7% and 80.7%; κ = .80 and .74), computed on a different basis (Oraee, 2024). These figures compare final codes. They do not measure how many breaches would be missed from the footage alone. Starting from 328 nonempty FH records and 341 NL records, the matching rules excluded six and 15 records

without an exact match, 24 and 23 with incomplete binary marker codes, and seven and three with no label selected by at least one coder, respectively. The 206 empty formatting rows in the FH sheet were not records. Online Resource 2 reports the full selection flow, agreement for each label and comparisons using each coder's own marker and decision codes.

8.5 Data conventions

All figures come from the final dataset of 3,212 timestamped breaches; two clip-level rows without timestamps were excluded. The source of the breach could not be coded for 96 breaches, of which 17 were decisions. The comparison between self-initiated and external breaches uses a logistic regression with standard errors clustered by participant (60 clusters; $z = 5.86$). Activity summaries combine Playing and Admin Tasks as Miscellaneous and exclude six breaches without an activity code. Later behaviours ("following behaviours" in the dataset) are counted once per breach. Some of their codes, such as identifying possibilities, were developed together with the model (Oraee, 2024), so their association with decisions is not an independent test of it. For retry, the number of attempts includes the first one; a blank count means two attempts, and one episode was corrected to three after checking the source. The dataset records giving up under two labels: Give up, as a marker or a later behaviour, and Abandon, as a later behaviour only. In the paper, both are counted as give up, once per breach; the original labels are kept in the dataset. This pooled count describes coded discontinuation, not a single psychological process. Give up as a later behaviour occurred in 82 breaches and Abandon in 35; 11 contained both, giving 106 breaches with either later code. Twenty-nine of these also carried the initial Give up marker. Counting each breach once gives 135 breaches (46 participants): 58 with an initial marker and 77 with giving up only later. For the mutually exclusive initial-marker groups in Section 4.4, Give up takes precedence over Retry, then Pause, Hesitation or Scan, with the remaining breaches grouped as other. Later Shift and Continue codes are counted separately after the first give-up code; six breaches contain both, including one with a decision report. Repeated Give up

or Abandon labels are not counted as a different subsequent behaviour. Give up and Abandon remain separate in the data. We combine them only to count breaches involving giving up. The decision flag applies to the whole breach and does not establish that giving up itself was decided. The additional sensitivity checks were conducted after the main analyses. They use the exclusive pause/hesitation/scan and retry/give-up groups defined in Results. We compared decision rates using each coder's own codes, restricted the main dataset to RRIW participants, compared rates within participants who had breaches in both groups, and omitted each participant in turn. For 95% percentile intervals, we resampled participants 10,000 times, retaining their breaches together; the paired comparison gave each eligible participant equal weight. The intervals for the coder samples are exploratory because they involve only eight or nine participants (Online Resource 2).

8.6 Exceptions

The exceptions to the contrast between markers were spread across participants. The 11 non-decisional pauses came from ten participants, the 144 non-decisional scans from 38, and the 32 decisional retries from 16. Nine of the non-decisional pauses lasted 2–10 seconds; two durations are missing.

8.7 Status of the examples

The quotations come from the replay interviews reported in the thesis (Oraee, 2024). A non-decisional report means that the participant did not experience the breach as a decision. It does not show that no selection or control took place. Online Resource 2 follows one example from the footage and the thesis-reported interview exchange to its final dataset row, distinguishing an initial Retry from later Abandon and Give up codes.

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Competing interests. The authors declare none.

Ethics approval and consent. The study received ethical approval from the London School of Economics Departmental Research Ethics Committee (REC reference 25112) and was conducted in accordance with the SEBE ethical guidelines. All participants gave informed consent, including to the publication of anonymised verbatim quotations and of the images reproduced in Fig. 1.

Related manuscripts. This paper uses the doctoral corpus reported in Oraee (2024). Two companion manuscripts use the same corpus: one presents micro decision-making through qualitative illustrations, the other presents the replay interview protocol and the reliability of the coding. The present paper reports different analyses (decision rates, sequences, retry and give-up) and proposes the model. The companion manuscripts can be provided to the editor.

Data availability. Online Resource 2 reports the additional agreement and sensitivity checks. Online Resource 3 contains the de-identified data extracts and code needed to reproduce these checks, including the matching and exclusions. The full de-identified coding dataset of the 3,212 breaches, with markers, decisional status, source, activity type and later behaviours, the codebook and the analysis code can be obtained from the corresponding author on reasonable request, within the limits of consent and confidentiality. The full subcam corpus is not publicly available because it contains first-person video of participants' homes and of third parties. Selected extracts can be shared only where the relevant permissions allow. RRIW protocol templates (coding cards, a coding sheet and participant briefing script) and Online Resources 1–3 are available at https://osf.io/kmjnb/.

Author contributions. Atrina Oraee conducted the doctoral study, collected and curated the data, developed the replay procedure and the coding scheme, and led the empirical analyses. Saadi Lahlou supervised the study and contributed to the conceptual development, the interpretation and the writing. Both authors developed the model and revised the paper.

Use of generative AI. The authors used Claude (Anthropic) and ChatGPT (OpenAI) as writing and research assistants during the preparation of this article. They were used to restructure and condense successive drafts written by the authors, and to propose wording for some passages following the authors' instructions. They were also used to search for references and check them, and the quotations, against the original sources; to locate examples in the first author's thesis (Oraee, 2024); to develop and check code for the analyses of the coding dataset; and to draw the flowchart in Fig. 2 from the authors' design. No AI was used in the doctoral study itself: data collection, coding and classification were done by people. Fig. 1 consists of video stills; no photographic image was generated by AI. The authors reviewed, revised and approved all content, and take full responsibility for the article.

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