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Pain and Behaviour Diverge When Animals Adapt, Mask, or Reorganize Their Responses: A Multimodal Veterinary Framework Integrating Movement, Posture, Facial Expression, Activity, Feeding, Social Behavior, and Context

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ABSTRACT

Pain assessment in animals depends on observable consequences of an experience that cannot be directly reported or measured. Yet behaviour is neither a transparent readout of pain nor a stable signal across time. Animals may preserve feeding, suppress conspicuous responses, redistribute activity, adopt economical postures, or reorganize social and self-maintenance behaviour while pain persists. Conversely, fear, weakness, nausea, sedation, confinement, handling, and environmental novelty may produce pain-like changes. This article develops an original non-empirical framework for interpreting such convergence and divergence across movement and gait, posture and guarding, facial expression, activity and rest, feeding and drinking, grooming, social interaction, vocalization, and context. It proposes that assessment should distinguish the underlying pain state, the animal's capacity and motivation to express it, opportunities for observation, and the observer or technology that records the signal. No single domain is treated as compensatory for absent evidence elsewhere. Instead, domain-specific observations are interpreted jointly, longitudinally, and against within-animal baselines, plausible alternatives, and response to clinically justified intervention. Concordant change can strengthen concern without establishing pain specificity; discordance should trigger explanation rather than averaging. The framework therefore redirects attention from "Does this animal show pain behaviour?" to "Which pain-compatible changes are present, which expected signals are absent, and what could account for that pattern?" Its proposed classifications and decision logic require prospective, multispecies validation. They are not diagnostic thresholds and cannot substitute for clinical examination, etiological investigation, or welfare-sensitive action under uncertainty.

Keywords: Animal pain, Behavioural adaptation, Multimodal assessment, Signal discordance, Clinical reassessment, Animal welfare

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Introduction

Veterinary pain assessment addresses a latent state through consequences distributed across behaviour, function, physiology, and interaction. Internal-medicine evidence emphasizes that acute and chronic pain lack a single definitive diagnostic test and that available tools incompletely cover heterogeneous clinical presentations [1]. This problem is not simply insufficient observation. Chronic musculoskeletal pain in dogs has been associated with changes across physical, affective, environmental, and social welfare domains, demonstrating that clinically relevant disturbance is distributed rather than confined to one "pain behaviour" [2].

Interpretation also depends on the animal's history and trajectory. Quality-of-life and chronic-pain assessment in dogs supports repeated, individualized evaluation while cautioning that proxy-reported quality of life is related to, but not identical with, pain [3]. Contemporary veterinary guidance accordingly combines history, examination, validated instruments, repeated measurement, and response to intervention rather than relying on an isolated sign [4].

This article argues that pain and behaviour may diverge when expression is constrained, masked, adapted, or reorganized. It proposes a multimodal pain-behaviour framework that separates signal generation from signal observation, treats discordance as clinically informative, and prevents normality in one domain from cancelling concern in another. The framework is interpretive, not diagnostic: it organizes evidence and reassessment while preserving species, disease, temporal, contextual, and measurement boundaries.

Pain behavior as an imperfect signal

Behaviour is an effect of pain filtered through physical capacity, motivational priorities, learning, temperament, arousal, and environmental opportunity. The same nociceptive burden may therefore yield different visible patterns, whereas different non-pain states may yield similar patterns. Weakness can shorten stride; fear can freeze activity; nausea can reduce feeding; sedation can alter facial tone and social engagement. Because pain itself is not directly measurable, observation supports inference rather than direct detection [1].

Three separations are proposed. First, pain state is distinct from expressive capacity: an animal unable or unwilling to perform a response may still experience pain. Second, emitted behaviour is distinct from recorded behaviour: brief sampling, camera angle, observer presence, or housing can determine what becomes data. Third, recorded change is distinct from interpretation: even reliable detection may be nonspecific or clinically unactionable.

Accordingly, an absent sign should reduce confidence only when that sign was biologically expected, behaviourally possible, and adequately observable in the relevant context. A present sign should increase concern only in proportion to its validity and specificity. Multimodality does not mean counting abnormalities; it means adjudicating what each domain could and could not have shown.

Movement and gait

Movement can reveal load avoidance, reduced range, altered symmetry, hesitation, shortened excursions, or changed transitions. It is clinically valuable because it connects pain-compatible behaviour to function. However, movement is jointly determined by pain, age, muscle mass, cardiorespiratory capacity, obesity, neurologic function, motivation, surface, available space, and daily routine. In dogs with osteoarthritis-associated pain, activity patterns were influenced by age, hindlimb pain, and muscle atrophy, illustrating that movement should not be interpreted as a pain-specific output [5].

Measurement choices add a second layer of uncertainty. Standardized work in domestic dogs shows that accelerometer sampling and epoch selection alter quantified activity, so apparent biological differences may partly arise during data processing [6]. Gait observation and sensor-derived activity should therefore remain analytically distinct: one describes movement quality during selected tasks, whereas the other estimates accumulated movement under specific technical settings.

The proposed framework asks whether the animal could perform the observed task, chose to perform it, and had an opportunity to do so. Stable step counts do not exclude painful movement; reduced activity does not identify its cause. Useful interpretation compares tasks, surfaces, transitions, and time points while documenting technical parameters and plausible functional alternatives.

Posture and guarding

Posture can reduce tissue loading, protect a region, stabilize balance, or conserve effort. Guarding may appear as stiffness, bracing, altered weight distribution, abdominal tension, reluctance to lie down, or protection during palpation. These signs are often compelling because they are anatomically interpretable, but they are neither invariably present nor pain-specific. Weakness, dyspnoea, fear, neurologic impairment, conformation, restraint, cold, and unfamiliar flooring can produce similar configurations.

Interpretation should separate static position from transitions and task-contingent protection. A posture observed only in the clinic may reflect handling or vigilance; a repeatedly adopted posture before rising, eliminating, feeding, or settling may have greater functional coherence. Conversely, an animal may stop overtly guarding after learning a less costly movement strategy without improvement in the underlying condition.

Within the proposed framework, posture contributes most when anatomical plausibility, repetition, and coordination with other domains are preserved. It contributes less when observation is brief, the animal cannot adopt its normal repertoire, or competing explanations remain untested. Posture should therefore guide targeted examination and serial comparison, not operate as a stand-alone diagnostic sign. Its disappearance is evidence of changed expression, not automatically of analgesia or recovery [4].

Facial expression

Facial-expression scales formalize changes that clinicians might otherwise describe inconsistently. The Feline Grimace Scale was developed and validated using facial action units and demonstrated clinically useful measurement properties for acute pain in cats [7]. Such scales improve standardization, but their performance is bounded by species, condition, observation quality, training, and the state in which validation occurred. They measure an expression pattern, not pain independently of context.

Anatomical description also matters. Proposed refinements to the Horse Grimace Scale emphasize clearer feature definitions and equine facial anatomy, indicating that apparently simple labels can conceal ambiguity in what observers score [8]. Ear position, orbital tightening, muzzle tension, head carriage, and attention may also change with fear, fatigue, restraint, medication, or environmental monitoring.

The framework therefore treats facial expression as a temporally sampled domain whose credibility depends on visibility, species-appropriate descriptors, observer competence, and competing states. A clear grimace can strengthen concern, particularly when it co-varies with function or posture. A neutral face cannot cancel abnormalities elsewhere when expression is subtle, transient, suppressed, obscured, or technically unreadable. Facial scores should inform, but not dominate, multimodal adjudication.

Activity and rest

Activity and rest describe how behaviour is allocated over time, not merely how much movement occurs. Pain-compatible patterns include reduced exploration, shorter active bouts, fragmented rest, repeated repositioning, altered circadian distribution, or withdrawal from previously chosen activities. Yet identical totals can conceal different temporal organizations: an animal may maintain daily activity through fewer intense bouts, slower movement, or compensatory participation around essential routines.

Interpretive validity therefore depends on duration, setting, and measurement granularity. Device parameters can materially influence recorded activity [6], while clinical characteristics such as age and muscle condition shape real-world patterns independently of pain intensity [5]. Hospital rest may reflect illness severity, sedation, cage restriction, or disturbed sleep; home inactivity may reflect weather, caregiver schedule, or reduced opportunity.

The proposed framework separates capacity, choice, opportunity, and temporal structure. It prioritizes departures from an animal's established routine over universal activity expectations and asks whether rest appears restorative or disrupted. Improvement is more credible when activity quality, selected engagement, and comfortable rest change coherently. A rising activity count alone may reflect agitation or environmental demand, while quietness alone may reflect either comfort or suppression.

Feeding and drinking

Feeding and drinking are high-value welfare behaviours, but their preservation is a poor rule-out test. In alpha rams, acute pain after orchiectomy did not reduce interest in feed resources, showing that a biologically important or socially contested resource can maintain feeding despite pain [9]. Intake therefore reflects pain alongside appetite, nausea, thirst, competition, palatability, access, metabolic demand, learned routine, and the costs of approaching or positioning at a resource.

Farm-animal pain literature further indicates that behavioural responses vary by species, procedure, timing, and management context, supporting multimodal rather than appetite-only assessment [10]. Clinically, total consumption should be separated from latency to approach, effort, chewing or prehension, posture at the resource, interruption, selectivity, and post-feeding recovery. Drinking requires similar attention to access, posture, renal or endocrine disease, medication, and environmental temperature.

The proposed interpretation is asymmetric: reduced intake can increase concern but requires differential diagnosis, whereas preserved intake cannot negate concordant pain-compatible changes elsewhere. A return to eating after treatment is meaningful only if opportunity and competing causes are stable. Resource motivation, hierarchy, and caretaker presentation should be documented whenever feeding behaviour is used as reassessment evidence.

Grooming and self-maintenance

Grooming, coat care, scratching, stretching, elimination preparation, nesting, and other self-maintenance behaviours integrate mobility, flexibility, motivation, access, and species-typical sequencing. Pain may reduce grooming through difficulty reaching a region, interrupt normal bouts, redirect licking toward a painful site, or produce an unkempt coat. However, both loss and excess are nonspecific: dermatological disease, pruritus, nausea, stress, sedation, obesity, weakness, and environmental restriction may generate similar observations.

The clinically useful unit is not “grooming present or absent” but the configuration of target, sequence, effort, completion, and consequence. Preserved grooming may be highly routinized or selectively maintained while other self-care deteriorates. Repetitive licking may represent nociception, itch, displacement, or learned self-soothing. A coat-level endpoint can lag behind current pain, whereas difficulty entering a grooming posture may change quickly.

The framework therefore distinguishes maintenance outcome from maintenance process. It asks what the animal attempts, what biomechanical demand the behaviour imposes, and whether the act is completed comfortably. **Table 1** presents grooming task components that separate altered self-maintenance from nonspecific coat outcomes.

Table 1. Grooming task components that separate altered self-maintenance from nonspecific coat outcomes

Grooming task element	Pattern at task level	Biomechanical or contextual influence	Pain-consistent clue	Competing explanation	Repeat-observation design
Reduced reach	Incomplete care	Mobility, obesity	Stops at demanding posture	Weakness may mimic	**Clinical use:** Examine regional function **Repeat:** Recheck task **Basis:** Proposed
Preserved routine	Coat maintained	Habit	Normal bout; other changes persist	Behaviour may be prioritized	**Clinical use:** Pain not excluded **Repeat:** Compare effort **Basis:** Proposed
Focal overgrooming	Repetitive licking	Skin disease, stress	Site-directed repetition	Itch competes	**Clinical use:** Localize first **Repeat:** Track site/context **Basis:** Evidence-bounded
Interrupted sequence	Attempt without completion	Fatigue, fear	Pauses or abandonment	Observation may alter performance	**Clinical use:** Test biomechanical demand **Repeat:** Repeat when familiar **Basis:** Proposed

Note: Status identifies article-derived classifications; no row is a diagnostic rule or additive score.

Social interaction

Pain can alter proximity seeking, avoidance, tolerance of touch, play, aggression, affiliative contact, group position, or responsiveness to familiar caregivers. Qualitative behavioural assessment in dogs with acute pain identified whole-animal expressive changes, supporting attention to integrated demeanour rather than isolated acts [11]. Nevertheless, social behaviour is relational: the observed pattern depends on who is present, prior experience, group structure, handling, competition, and whether interaction is voluntary.

Pain and problem behaviour also overlap clinically. Reviews of cats and dogs describe pain as a possible contributor to aggression, fear-related responses, house-soiling, sleep disturbance, and other presenting complaints, while warning that behavioural change does not establish pain as the sole cause [12]. Social withdrawal may reflect pain, fear, sickness, fatigue, or environmental novelty; increased contact may reflect reassurance seeking rather than improvement.

The proposed framework therefore records partner identity, initiation, choice, termination, and context. It gives greater weight to reproducible within-animal change across familiar interactions and to patterns that cohere with movement, posture, or function. Social normality in a clinic cannot negate home change, and caregiver concern should prompt examination without being treated as diagnostic confirmation.

Vocalization

Vocalization may make pain conspicuous, but silence is especially vulnerable to misinterpretation. Species repertoire, temperament, social audience, handling, arousal, prior learning, and the painful event shape whether animals call, growl, whimper, grunt, or remain quiet. Vocal output can also accompany fear, restraint, separation, excitement, respiratory difficulty, or anticipation; a call is therefore neither a direct measure nor a pain-specific sign [12].

Assessment should characterize form, timing, trigger, recipient, and deviation from the animal's usual repertoire. Procedure-linked vocalization may indicate acute distress without identifying its sensory or affective components. Spontaneous vocalization at rest may be clinically salient yet still require localization and differential diagnosis. In production settings, environmental noise and group observation can obscure both emitter and context.

The proposed framework treats vocalization as an intermittent event domain rather than a required symptom. Silence should carry little negative evidential weight unless vocal expression was reasonably expected and observable. New, reproducible vocal change can strengthen concern when it aligns with posture, movement, interaction, or examination, but should prompt investigation rather than automatic attribution.

Context and environmental modulation

Behavioural evidence changes with observation conditions. A systematic review of cattle pain scales found substantial heterogeneity in instruments and assessment contexts, limiting simple comparison and supporting explicit documentation of procedure, observer, timing, and scale properties [13]. Real-time and video assessment in surgically castrated cattle also differed in clinically relevant ways, showing that observation mode can influence reliability and what behaviours remain visible [14]. At home, cat guardians' recognition and veterinary decisions depend on which changes they notice and interpret as pain-compatible [15].

Context therefore enters twice: it modifies what the animal expresses and what the assessor can detect. Handling, transport, novelty, conspecifics, resource competition, flooring, enclosure, caregiver presence, camera position, and time of day may amplify, suppress, or redirect behaviour. No observation is context-free.

The framework records an observation-context profile alongside each domain: setting, opportunity, audience, observer, modality, and temporal window. Evidence across cattle scales, observation modes, and guardian interpretation supports this separation of animal signal from observation process [13–15]. Cross-context consistency may strengthen confidence, whereas inconsistency should identify a testable contextual modifier rather than be dismissed as noise.

Masking and suppression

Masking is used here descriptively, not as proof of deliberate concealment. It denotes a pain-compatible state in which expected behaviour is attenuated, displaced, or unavailable because another priority or constraint dominates expression. Resource motivation can preserve feeding during acute pain [9]; vigilance, unfamiliar observers, restraint, social competition, or learned consequences may likewise suppress vulnerable behaviours. Video and real-time assessments need not expose the same repertoire [14].

Suppression must be distinguished from measurement failure. An animal may emit a subtle response that the observer misses, or may not emit it because posture, housing, weakness, or fear prevents performance. Both produce apparent normality but imply different corrective actions: improve observation in the first case; examine capacity and competing motivation in the second.

The proposed framework therefore prohibits "absence equals comfort" unless expression opportunity is adequate. Suspected masking should trigger quieter observation, familiar settings, caregiver video, repeated sampling, or alternative domains rather than coercive provocation. Because masking is difficult to verify directly, it remains an explanatory hypothesis. It gains plausibility when context changes reveal the response or when other pain-compatible domains and clinical findings remain coherent.

Adaptation and behavioral reorganization

Adaptation differs from recovery. Chronic neuropathic pain across companion animals and humans can involve persistent sensory and functional disturbance despite changes in outward coping, emphasizing that expression may evolve while pain remains [16]. In cats with osteoarthritis, a clinician instrument was validated through responsiveness to firocoxib, illustrating how longitudinal functional change can provide information beyond a single observation [17]. Reviews of facial pain expression likewise describe temporal, species, procedural, and observer limits that prevent a stable facial signal from representing the full pain course [18].

Behavioural reorganization may preserve valued outcomes through new means: slower routes, fewer transitions, altered resting sites, selective grooming, changed social timing, or concentrated activity around essential resources. Such compensation can make totals appear normal while effort, sequence, or recovery cost changes. Conversely, learned avoidance may persist after nociceptive improvement.

This article therefore proposes three separable interpretations: accommodation with continuing burden; protective avoidance that may be adaptive in the short term; and residual learned organization after improvement. None can be assigned from behaviour alone. **Table 2** presents behavioral reorganization mechanisms that can preserve function without demonstrating pain resolution.

Table 2. Behavioral reorganization mechanisms that can preserve function without demonstrating pain resolution

Reorganization mechanism	Function preserved or omitted	Why outward totals can mislead	Test separating persistent pain from learned organization
Type: Costly accommodation **Response:** Outcome preserved by altered method	**Driver:** Chronicity, reserve **Pattern:** Slower sequence; longer recovery	**Clinical implication:** Examine hidden effort **Uncertainty:** Pain may persist	**Test:** Compare process over time **Basis:** Proposed
Type: Protective avoidance **Response:** Demanding act omitted	**Driver:** Tissue threat, fear **Pattern:** Selective task refusal	**Clinical implication:** Respect protection; investigate **Uncertainty:** Short-term value uncertain	**Test:** Reassess after stabilization **Basis:** Proposed
Type: Priority preservation **Response:** Essential act maintained	**Driver:** Resource/social value **Pattern:** Normal total; altered timing	**Clinical implication:** Do not infer comfort **Uncertainty:** Motivation competes	**Test:** Examine adjacent domains **Basis:** Proposed
Type: Residual organization **Response:** Learned pattern persists	**Driver:** Memory, habit **Pattern:** Avoidance after clinical change	**Clinical implication:** Test current capacity **Uncertainty:** Pain may have improved	**Test:** Seek reversible change **Basis:** Proposed

Note: The ledger organizes competing interpretations; entries are not validated stages, diagnostic thresholds, or treatment rules.

Individual and species variation

Species-specific repertoires determine which behaviours are possible, salient, and validated. Facial action units developed for cats cannot be transferred unchanged to horses, while cattle instruments differ in content and measurement quality [7, 8]. Farm-animal evidence also reflects procedure, management, and production context rather than a universal livestock phenotype [10]. Even within a species, breed, conformation, age, temperament, prior experience, disease, medication, and social role alter expression.

Individualization should not become unstructured intuition. A within-animal baseline requires repeatable observation conditions and defined behaviours; otherwise familiarity may increase confidence without improving validity. Equally, a population-derived instrument should not erase meaningful deviation from an animal's usual function. Systematic evaluations of grimace and farm-animal scales support attention to reliability, validity, responsiveness, and intended use rather than assuming that a named tool travels across settings [19, 20].

The framework therefore uses species-valid instruments where available, supplements them with defined individualized observations, and records when neither route is secure. Transfer across species, breeds, etiologies, or care environments is an empirical question. Unvalidated adaptation should be labelled provisional rather than disguised as clinical calibration.

A proposed multimodal pain-behavior framework

The framework separates four linked layers. The latent clinical layer contains possible pain and competing conditions. The expression layer contains capacity, motivation, adaptation, and prioritization. The observation layer contains setting, opportunity, observer, technology, and sampling. The adjudication layer integrates domain patterns with examination, history, plausible alternatives, and serial response. This separation prevents a technically reliable behavioural detection from being treated automatically as pain-specific or actionable.

Eight behavioural domains remain parallel: movement and gait; posture and guarding; facial expression; activity and rest; feeding and drinking; grooming and self-maintenance; social interaction; and vocalization. Context is a cross-cutting modifier, not a ninth vote. Technology may expand sampling, but algorithmic pain-recognition reviews identify dataset, label, generalization, and deployment constraints [21]. Measurement-property reviews of grimace scales and farm-animal instruments similarly show that validity is tool-, species-, construct-, and setting-dependent [19, 20]. Together, these sources justify preserving technology, instrument quality, and species boundaries rather than collapsing outputs into one score [19–21].

Figure 1 is needed because the framework's noncompensatory boundaries and conditional connectors cannot be recovered from a linear checklist.

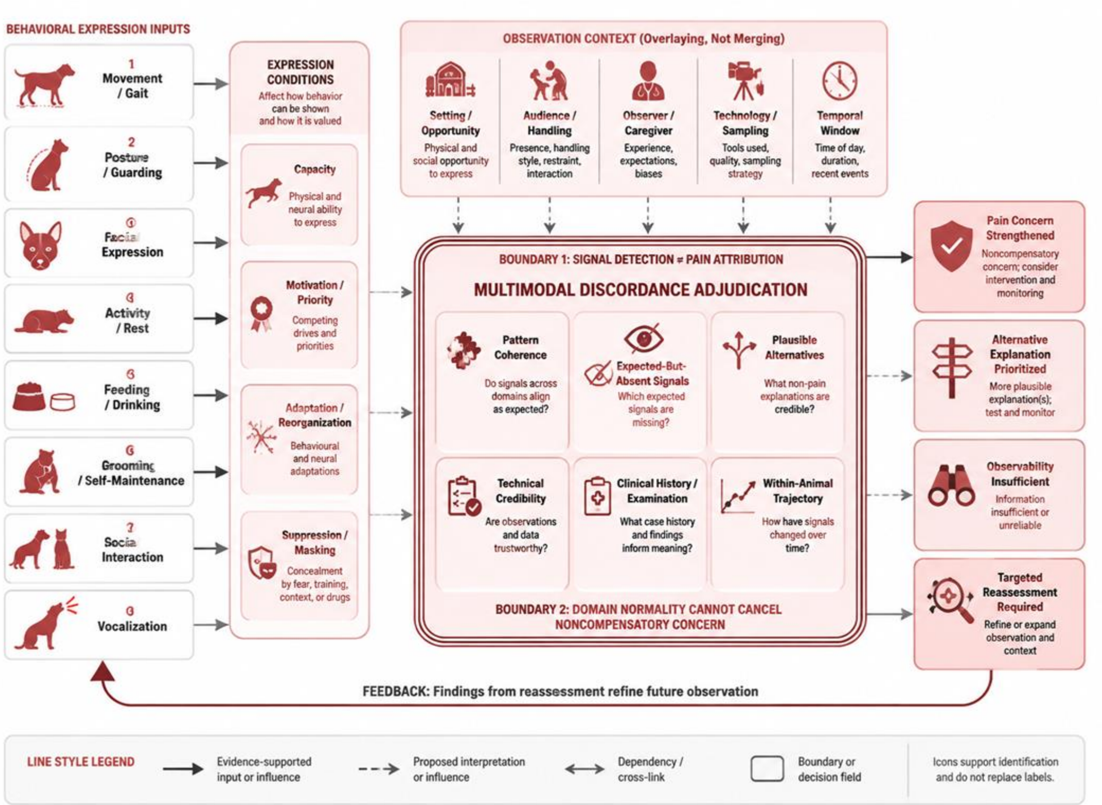

Figure 1. Discordance adjudication field for pain-compatible behaviour under constrained expression

Parallel behavioural domains feed a bounded adjudication field through context-qualified observations. Solid arrows denote evidence-supported assessment inputs; dashed arrows denote proposed interpretations; blunt boundaries prevent normality in one domain from cancelling concern elsewhere. A feedback loop returns decisions to targeted reassessment. The architecture is proposed; domain measures retain their source-specific validity limits.

Concordant and discordant signal states

Concordance occurs when several credible domains change in mutually compatible ways under adequate observation. It can strengthen concern and anatomical or functional coherence, but shared confounding remains possible: sedation may simultaneously alter activity, face, feeding, and social response. Concordance therefore increases evidential consistency, not diagnostic certainty.

Discordance is more heterogeneous. The article proposes four states: preserved-priority discordance, in which feeding or social contact remains despite other changes; capacity-limited discordance, in which a response cannot be expressed; context-shift discordance, in which home and clinic observations differ; and temporal discordance, in which domains change at different rates. A fifth state, technical discordance, arises when device, camera, scale, or observer outputs conflict.

These states should not be averaged into a composite impression. The clinician should identify which domain is credible, which absence was expected, and which modifier could explain the mismatch. Discordance may lower confidence, reveal a competing diagnosis, or expose an informative adaptation. It becomes actionable only when linked to a targeted next observation, examination, or reassessment condition.

Clinical reassessment

Reassessment should test an explicit interpretation rather than merely repeat the same uncertain observation. Dog owners' decisions about pain-compatible behavioural change show that recognition and help-seeking depend on interpretation, supporting structured caregiver questions about onset, context, task, and deviation from baseline [22]. A behaviour-based scale for canine lumbosacral pain illustrates the value of condition-focused instrument development while remaining bounded by its validation population and purpose [23]. A hospital bovine pain scale likewise demonstrates that setting-specific tools require their own measurement evidence [24].

The proposed reassessment loop has four steps: state the working explanation; select the domain and context most capable of discriminating it; repeat measurement after a justified clinical or environmental change; and update concern without treating response as etiological proof. Analgesic response may support pain involvement, but spontaneous fluctuation, sedation, concurrent treatment, learning, and regression toward usual behaviour remain alternatives.

Figure 2 distinguishes reassessment that resolves uncertainty from repetition that preserves the same observation failure.

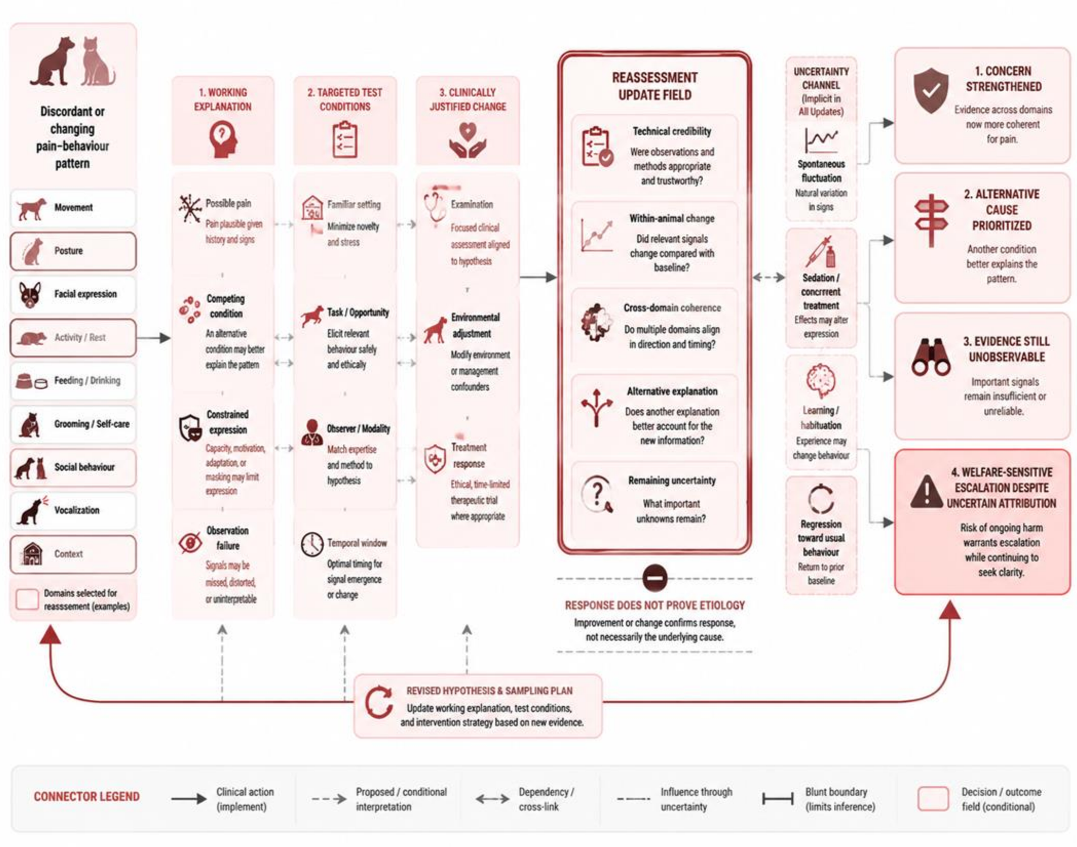

Figure 2. Reassessment loop that tests discordance instead of repeating an uninformative observation

A working explanation directs domain- and context-specific reassessment. Solid arrows show clinical actions; dashed branches show revisable interpretations; an uncertainty channel retains competing causes and treatment confounding. Escalation occurs when welfare risk is material even if attribution remains incomplete. The loop is proposed and requires prospective validation.

Welfare implications

If visible behaviour can normalize while burden persists, welfare assessment based on conspicuous abnormality risks false reassurance. The relevant welfare question is not only whether an animal performs a behaviour, but whether it can perform it comfortably, voluntarily, completely, and without disproportionate recovery cost. Preserved feeding, grooming, social contact, or activity may coexist with narrowed choice and reduced positive engagement.

The opposite error is also consequential. Treating every withdrawal, grimace-like feature, or altered gait as pain may obscure fear, sickness, neurologic disease, environmental deprivation, or medication effects. Welfare-sensitive assessment therefore requires both precaution and differential reasoning. Uncertainty should alter observation, examination, and support; it should not justify either reflexive dismissal or unbounded attribution.

The proposed framework makes noncompensatory constraints explicit: severe functional loss, inability to rest, escalating distress, or threatened access to essential resources warrants action even when domains disagree. This is an ethical orientation rather than an effectiveness claim. Clinical responsibility, feasible care, production-system constraints, and the animal's opportunity for agency remain essential to any decision.

Validation priorities

Validation should test the framework's distinctions, not merely whether more variables improve classification. Measurement studies should report construct definitions, content validity, reliability, measurement error, responsiveness, and intended interpretation transparently; COSMIN guidance provides a methodological foundation for such reporting, although it was developed for patient-reported measures and requires veterinary adaptation [25].

Artificial-intelligence comparisons in sheep show that algorithmic and human performance can be evaluated under defined acute-pain conditions, but sampled procedures, labels, species, and settings bound inference [26]. Recent cattle video models similarly require caution concerning source-sample size, etiology, breed, housing, binary states, and distribution shift before clinical deployment [27]. Transparent measurement design, external testing, and domain-shift evaluation are therefore jointly required [25–27].

Priority studies should prospectively compare single-domain with discordance-aware assessment; test within-animal trajectories across acute and chronic conditions; manipulate observation context ethically; and evaluate interobserver, caregiver–clinician, real-time–video, and device–human disagreement. Multisite validation should include different species, breeds, ages, etiologies, housing systems, and care resources. Decision-impact studies must separately examine diagnostic accuracy, treatment change, welfare outcomes, workload, and unintended harm. Falsification is essential: the framework should be revised or rejected if its proposed states do not improve calibrated interpretation beyond validated instruments and clinical examination.

Conclusion

Pain behaviour is neither absent simply because one valued activity persists nor confirmed because several nonspecific signs align. Animals can suppress, redistribute, or reorganize responses; observers and technologies can further reshape what becomes evidence. The proposed framework preserves movement, posture, facial expression, activity, feeding, grooming, social interaction, vocalization, and context as analytically distinct but jointly interpreted domains. Its central contribution is to treat discordance as a question requiring explanation, not an inconvenience to be averaged away. Assessment should ask whether a response was biologically possible, motivationally likely, observable, technically credible, and coherent with clinical findings and trajectory. Reassessment should test explicit alternatives while welfare-sensitive action remains possible under uncertainty. The framework is not a diagnostic score, validated mechanism, or universal protocol. Its value depends on prospective testing, species-appropriate measurement, transparent boundaries, and evidence that it improves decisions without introducing new harms.

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