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The Integrated Behavioral-Socioecological Framework (IBSF): Unifying Behavioral Mechanisms and Multi-Level Context for Health Behavior Research

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Abstract

Background

Health behavior research relies on a fragmented theoretical landscape, with reviews identifying more than eighty distinct models across the behavioral and social sciences. Existing synthesis efforts, including the Capability, Opportunity, Motivation, and Behavior (COM-B) model and Theoretical Domains Framework (TDF), have advanced the organization of behavioral constructs but do not stratify mechanisms across nested socioecological contexts. A critical gap remains in organizing behavioral determinants simultaneously across behavioral mechanisms and socioecological levels within a unified analytic system.

Methods

The Integrated Behavioral-Socioecological Framework (IBSF) was developed through an iterative theoretical synthesis involving framework identification and selection, construct mapping, and matrix consolidation. Five complementary frameworks were integrated: COM-B, TDF, the Health Belief Model (HBM), Theory of Planned Behavior (TPB), and Social Ecological Model (SEM). Constructs were mapped across behavioral domains and socioecological levels within a matrix-based structure. Conceptual overlap was interpreted as an expected characteristic of complex behavioral systems rather than redundancy requiring elimination.

Results

IBSF organizes behavioral determinants within a unified matrix, intersecting capability, opportunity, and motivation with individual, social, and environmental levels of influence. The framework preserves overlapping and interacting behavioral influences across levels of context, enabling simultaneous examination of behavioral mechanisms and the contexts in which they operate. Opportunity and motivation function as dynamic bridging domains, linking internal behavioral processes with external social and structural influences. IBSF has been applied across qualitative research, educational development, outreach planning, and community engagement within a public health research program examining barriers to cancer clinical trial participation in rural populations.

Conclusions

IBSF provides a theoretically grounded and operationally applicable framework for organizing interacting behavioral determinants across cognitive, motivational, social, and environmental domains. By treating conceptual overlap as an expected characteristic of complex behavioral systems, IBSF supports balancing conceptual depth with practical usability for future multi-level behavioral research.

Contributions to the Literature

- Behavioral frameworks are often used separately, without a unified analytic structure for organizing determinants across both behavioral mechanisms and socioecological levels.
- IBSF integrates COM-B, TDF, HBM, TPB, and SEM into a single matrix-based framework across behavioral domains and socioecological levels.
- Within IBSF, overlap between frameworks is treated as meaningful rather than redundant, reflecting how behavioral determinants naturally interact across complex systems.

1 Background

1.1 The Behavioral Theory Landscape

Health behavior is shaped through complex interactions among cognitive, emotional, social, environmental, and structural determinants operating across multiple levels of influence. Over decades of behavioral and public health research, a substantial

number of theoretical frameworks have been developed to explain these interactions, with reviews identifying over eighty distinct theories and models across the behavioral and social sciences.(1, 2) These frameworks span a wide range of disciplinary traditions and levels of analysis, from individually focused cognitive models emphasizing perception, intention, and decision-making, to interpersonal and social theories addressing normative influence, identity, and relational dynamics, to structural and ecological perspectives emphasizing environmental conditions, institutional systems, and policy contexts.(3–6)

Foundational frameworks that focus on the individual include the Health Belief Model (HBM), Theory of Planned Behavior (TPB), Social Cognitive Theory, Transtheoretical Model, Protection Motivation Theory, and Self-Determination Theory. These models each contribute distinct insights into how individuals perceive, evaluate, and engage with health-relevant behaviors.(3, 7–11) Broader behavioral synthesis frameworks, including the Capability, Opportunity, Motivation, and Behavior (COM-B) model and Theoretical Domains Framework (TDF), have advanced integration across cognitive, motivational, and contextual determinants and have been widely adopted in implementation and behavior change research.(2) Socioecological frameworks, including the Social Ecological Model (SEM), have emphasized the nested structural and environmental conditions shaping behavioral engagement across individual, interpersonal, organizational, community, and policy levels.(6, 12, 13) This theoretical breadth reflects genuine complexity in the determinants of health behavior. However, it has also produced persistent challenges for researchers and practitioners seeking to apply behavioral theory systematically. The proliferation of frameworks has resulted in substantial conceptual overlap. As a result, behavioral frameworks are frequently applied independently or in parallel with theoretical integration often remaining implicit, inconsistent, or constrained within disciplinary silos rather than organized within unified analytic structures capable of representing interacting determinants across levels of influence.

1.2 Existing Integration Efforts and Rationale for the Integrated Behavioral-Socioecological Framework

Efforts to address fragmentation through theoretical combinations have taken several forms. Some researchers have applied multiple frameworks simultaneously, drawing on different theories to address different dimensions of a research question. For example, using HBM to examine individual risk perceptions while applying SEM to contextualize structural influences.(6, 7) Others have mapped constructs across frameworks to identify areas of conceptual equivalence or have used consensus processes to consolidate overlapping determinants into shared taxonomies.(14–16) The Behavior Change Wheel represented a significant advance in this direction, synthesizing nineteen behavioral theories and positioning COM-B as a parsimonious central structure for behavioral analysis.(17, 18) The TDF similarly grouped constructs from multiple psychological theories into twelve theoretical domains intended to support systematic behavioral diagnosis and intervention development.(14) At the same time, socioecological and systems-oriented approaches emphasized the importance of understanding behavior as emerging through interaction among individual, interpersonal, organizational, environmental, and structural conditions operating across levels of influence.(6, 12, 19) These perspectives highlighted the importance of contextual organization but often lacked similarly organized behavioral mechanism structures.

These efforts have substantially improved the organization and operationalization of behavioral determinants. However, important limitations remain. Parallel application of multiple frameworks, while common, is frequently implicit and lacks a unified analytic structure capable of systematically organizing interacting determinants across theoretical traditions. (16, 20–22) Construct mapping efforts have improved comparability but have not consistently produced frameworks capable of simultaneously organizing behavioral mechanisms and socioecological context within a single analytic system. The Integrated Behavioral-Socioecological Framework (IBSF) was developed to address this persistent gap. Rather than proposing an entirely new behavioral theory, IBSF was designed to organize existing theoretical contributions within a unified multi-level analytic structure capable of representing interacting behavioral determinants across cognitive, motivational, social, and environmental domains simultaneously.

The purpose of this manuscript is to describe the development, structure, and operational organization of IBSF. This manuscript details the synthesis of overlapping behavioral determinants across established theories, presents the operational matrix underlying IBSF, and discusses its application to qualitative analysis, intervention planning, educational development, implementation research and public health practice.

2 Methods

2.1 Development of the IBSF

The IBSF emerged from a multistage integration of behavioral theories and frameworks designed to create a cohesive structure for examining cognitive, motivational, social, and environmental influences on behavior. The development of IBSF took place over three stages: identifying relevant frameworks, synthesizing and aligning the theoretical constructs of these models, and consolidating and refining the resulting matrix.

2.1.1 Rationale for Integration

Framework selection followed an iterative and purposive process guided by the organizational aims of IBSF. Included frameworks were selected based on their widespread application within behavioral and public health research, complementary contributions across cognitive, motivational, social, and environmental domains, and collective capacity to support integration within a unified multi-level analytic structure. COM-B and TDF contributed organization of behavioral mechanisms and implementation-oriented determinants, HBM and TPB contributed construct-level specificity related to cognitive evaluation, perceived risk, social influence, and intentional processes, and SEM contributed broader socioecological organization across levels of influence.

The selection process was not intended to produce an exhaustive synthesis of all behavioral theories. Rather, frameworks were selected based on their relevance to the conceptual and operational objectives of IBSF and their collective capacity to support organization of interacting behavioral determinants across multiple domains and levels of influence. This approach is consistent with established methods of iterative theoretical synthesis and integrative framework development within behavioral and implementation science research.(2, 18)

2.1.2 Theoretical Synthesis and Construct Mapping

Constructs from included frameworks were mapped across two dimensions. The first dimension aligned overlapping behavioral constructs within the higher-order COM-B domains of capability, opportunity, and motivation. Constructs demonstrating conceptual equivalence or functional similarity across frameworks were identified and consolidated while preserving their underlying theoretical relationships. For example, self-efficacy (HBM), perceived behavioral control (TPB), and beliefs about capabilities (TDF) were identified as functionally aligned constructs reflecting individual perceptions of behavioral capacity and were combined within the capability domain accordingly.(3, 7, 14)

The second dimension organized consolidated determinants across socioecological levels derived from SEM. While SEM is frequently represented across five levels, IBSF condensed these into three analytically coherent levels, individual, social, and environmental, to improve interpretability while preserving conceptual breadth.(6) Individual-level determinants include cognitive, emotional, and capability-related influences. Social-level determinants encompass interpersonal, organizational, and normative influences. Environmental level determinants reflect structural, institutional, and resource-related conditions.

Importantly, the synthesis process recognized that constructs frequently demonstrated influence across multiple domains and levels simultaneously. Rather than enforcing rigid categorization, overlapping determinants were interpreted as analytically meaningful indicators of shared behavioral mechanisms recurring across theoretical traditions, a characteristic of complex behavioral systems rather than a limitation of the synthesis process.

Constructs demonstrating conceptual equivalence or functional similarity across frameworks were identified and grouped while preserving their underlying theoretical relationships. Detailed conceptual mapping relationships identified during theoretical synthesis are illustrated in Supplementary Fig. 1.

2.1.3 Matrix Consolidation and Refinement

The intersection of these two analytical dimensions produced the IBSF matrix structure, organizing behavioral determinants according to both socioecological level and behavioral domain. The matrix underwent iterative refinement to improve clarity, reduce redundancy, and ensure theoretical relationships were preserved across consolidated constructs. This process included evaluation of construct placement, identification of cross-domain and cross-level relationships, and simplification of the visual representation to support practical usability without sacrificing conceptual depth. IBSF was designed to improve interpretability and operational usability while preserving conceptual breadth across overlapping behavioral determinants. Primary placement decisions were

guided by each construct's dominant theoretical function within its source framework. Cross-domain references were retained when constructs or construct groupings also contributed meaningfully to adjacent behavioral domains or socioecological levels. Allowing the matrix to preserve theoretically meaningful overlap while maintaining an operationally usable structure.

The resulting framework was designed to function as both a conceptual structure for theoretical integration and an operational analytic tool capable of supporting data analysis, intervention planning, educational development, implementation research, and applied public health practice.

3 Results

3.1 IBSF Structure

IBSF organizes determinants of health behavior within a unified multi-level framework integrating individual, social, and environmental influences with the behavioral domains of capability, opportunity, and motivation. These domains retain the COM-B structure while incorporating construct-level contributions from TDF, HBM, TPB, and SEM within the matrix.

Figure 1 presents the primary conceptual structure of IBSF by illustrating the interaction of behavioral domains across socioecological levels within a unified analytic system. Table 1 operationalizes this structure by organizing behavioral determinants across behavioral domains and socioecological levels while preserving the overlapping and interacting influences identified during theoretical synthesis. Constructs are positioned according to their primary domains and levels of influence, with bolded cross-domain references used to indicate areas where determinant groupings also operate across adjacent behavioral processes or contextual conditions. Supplementary Fig. 1 provides additional conceptual mapping detail regarding overlap and construct alignment across included frameworks. Together, Fig. 1, Table 1, and Supplementary Fig. 1 provide complementary representations of the framework. Figure 1 illustrates the overall matrix structure of IBSF conceptually, Table 1 provides a construct-level operational representation of determinants within that structure, and Supplementary Fig. 1 details how constructs from included behavioral theories were synthesized and aligned.

Table 1
Mapping of Behavioral Constructs Across Domains and Levels

	Individual (SEM)			Social (SEM)		Environmental (SEM)	
Capability	Physical Capability (COM-B)	Skills (TDF)					
	Psychological Capability (COM-B)	Knowledge (TDF)					
		Self-Efficacy (HBM)/ Perceived Behavioral Control (TPB)/ Beliefs about Capabilities (TDF)					
		Beliefs about Consequences (TDF)/ Perceived Severity & Susceptibility (HBM)/ Perceived Benefits & Barriers (HBM)					
Motivation	Automatic Motivation (COM-B)/ Individual Motivation (TDF)	Emotion (TDF)		Automatic Motivation (COM-B)/ Social Motivation (TDF)	Social Reinforcement & Influences (TDF)		
		Individual Reinforcement (TDF)			Shared Goals (TDF)		
	Reflective Motivation (COM-B)	Goals (TDF)		Reflective Motivation (COM-B)	Subjective Norms (TPB)		
		Capability and Perceived Behavioral Control			Social & Professional Role & Identity (TDF)		
Opportunity	Individual Opportunity (COM-B)	Physical Opportunity	Skills (TDF)	Social Opportunity (COM-B)	Subjective Norms (TPB)	Environmental Opportunity (COM-B)	Environmental Context (TDF)
		Capability & Perceived Behavioral Control	Awareness of Resources (TDF)		Social Influences (TDF)		Resources (TDF)
			Internal Cues to Action (HBM)		Social & Professional Role & Identity (TDF)		
			Access to Knowledge (TDF)		Social Cues to Action (HBM)		
					Social Reinforcement (TDF)		

Behavioral determinants within IBSF are organized according to their primary behavioral domains and socioecological levels of influence; however, these determinants are understood as interactive, overlapping, and context-dependent rather than discrete or mutually exclusive theoretical categories. Consistent with the behavioral pathway illustrated in Fig. 1, Behavioral Intention and Behavior are presented separately from the primary matrix because they represent outcomes arising from the interaction of determinants rather than determinants themselves. Constructs may operate across multiple behavioral domains and socioecological levels simultaneously, reflecting the interconnected nature of behavioral systems and the recurring overlap identified across included behavioral theories.
Bolded entries indicate cross-domain references to construct groupings that are primarily represented elsewhere in the table but are repeated within adjacent domains to show conceptual overlap. These bold sections are intended to clarify where constructs may function across capability, motivation, opportunity, and socioecological levels, rather than to suggest that they are duplicated as independent categories. For example, knowledge and skills are primarily aligned with individual capability, but access to knowledge, awareness of resources, and the ability to navigate available supports also reflect opportunity-related processes. Similarly, perceived benefits and barriers may function as individual appraisals while also reflecting social and environmental opportunity conditions.
Empty cells indicate that no construct was assigned a primary placement at that socioecological level within the corresponding behavioral domain. Notably, several constructs placed within the Opportunity domain carry meaningful motivational functions at the social level: Subjective Norms (TPB), while primarily an opportunity-level social construct, directly influences behavioral intention and motivation through perceived social pressure; Social Reinforcement (TDF), while placed under Social Opportunity, shapes motivational processes through external feedback and community validation. Their placement reflects primary domain assignment consistent with Supplementary Fig. 1, while their motivational functions are acknowledged as cross-domain influences consistent with the framework's treatment of conceptual overlap as analytically meaningful.

This framework was developed to support simultaneous examination of cognitive, social, environmental, and contextual determinants of behavior within a unified analytic system. Rather than positioning behavioral influences within isolated theoretical categories, IBSF organizes overlapping determinants across interacting domains and levels of influence while preserving conceptual relationships identified during theoretical synthesis.

3.1.1 Multi-Level Organization

IBSF is organized across three socioecological levels: individual, social, and environmental. Individual-level determinants include cognitive, emotional, and capability-related influences. Social-level determinants encompass interpersonal, normative, and organizational influences, while environmental-level determinants reflect structural, institutional, and resource-related conditions. Table 1 illustrates how these determinants are organized across behavioral domains and levels of influence within the IBSF structure.

3.1.2 Core Behavioral Domains

Within this structure, IBSF aligns behavioral determinants within the COM-B domains of capability, opportunity, and motivation.(18) Within IBSF, these domains function as higher-order organizational categories through which interacting cognitive, social, motivational, and contextual determinants can be interpreted across multiple levels of influence rather than as isolated or fully discrete behavioral processes. Capability primarily reflects individual-level determinants associated with physical and psychological capacity, including knowledge, skills, self-efficacy, perceived behavioral control, and beliefs about capabilities. Opportunity functions as a bridging domain extending across individual, social, and environmental contexts and includes physical opportunity, social opportunity, environmental context, access to resources, and social influences affecting behavioral engagement. Capability-related determinants may additionally interact with opportunity structures, as access to environmental resources, social support, and contextual accommodations may influence the extent to which individual knowledge, skills, and perceived capability can be translated into behavioral engagement.

Motivation encompasses both reflective and automatic processes influencing behavior, including goals, intentions, beliefs, emotional responses, reinforcement processes, and attitudes toward behavior. Reflective motivational determinants include processes associated with evaluation, planning, perceived consequences, susceptibility, severity, and behavioral intention formation. Automatic motivational determinants include emotion, reinforcement, affective processes, and habitual behavioral influences.

Although motivational processes are frequently conceptualized as internal behavioral determinants, IBSF additionally recognizes motivation as partially shaped through socially mediated influences operating across interpersonal and socioecological contexts. Subjective norms, social influences, identity-related processes, reinforcement mechanisms, and social evaluation may all contribute

to motivational engagement across both individual and social levels of influence. Within IBSF, motivation therefore functions not solely as an internal cognitive process, but also as a partially bridging domain influenced through interactions among personal, interpersonal, contextual, and environmental conditions.

Several determinants operate across multiple domains and socioecological levels simultaneously. Subjective norms and social influences function within social opportunity while also contributing to reflective motivational processes associated with intention formation and behavioral evaluation. Similarly, perceived barriers and perceived benefits interact across opportunity and motivational domains depending upon contextual conditions and environmental constraints. IBSF therefore conceptualizes behavioral determinants as interconnected, context-dependent influences operating across multiple behavioral processes rather than as isolated variables functioning independently.

3.1.3 Operational Representation of Overlapping Determinants

IBSF reflects substantial conceptual overlap across behavioral theories. During theoretical synthesis, constructs demonstrating conceptual equivalence or functional similarity were organized within higher-order behavioral domains while preserving their underlying theoretical relationships. Rather than treating overlap as redundancy requiring elimination, IBSF interprets recurring overlap across theories as indicative of shared behavioral mechanisms operating across cognitive, motivational, social, and environmental systems.

Table 1 operationalizes these relationships within a matrix-based structure that organizes determinants according to both socioecological level and behavioral domain. Several constructs intentionally appear across multiple domains or levels to reflect interacting behavioral influences operating across contexts simultaneously. Placement within the matrix reflects primary rather than exclusive domains of influence.

For example, self-efficacy (HBM), perceived behavioral control (TPB), and beliefs about capabilities (TDF) demonstrated substantial conceptual alignment related to perceptions of behavioral capacity and control and were therefore integrated primarily within the capability domain. Similarly, subjective norms (TPB) and social influences (TDF) demonstrated overlapping influence across social opportunity and reflective motivational processes. Additional overlaps emerged among constructs related to reinforcement, perceived barriers, emotional responses, beliefs about consequences, and behavioral intentions.

3.1.4 Behavioral Pathway

IBSF incorporates a behavioral pathway linking cues to action, intention, and behavior. Internal and external cues interact with capability, opportunity, and motivational processes to influence behavioral intention, which functions as a proximal determinant of behavioral engagement. Behavioral intention is additionally shaped through interactions among reflective evaluation, social influence, perceived consequences, emotional responses, and contextual opportunity structures operating across socioecological levels.

Within IBSF, behavior is conceptualized as an emergent outcome arising through dynamic interactions among cognitive, social, emotional, environmental, and contextual determinants rather than through isolated linear causal processes. This structure allows the framework to represent the complexity of behavioral engagement while supporting organization and interpretation of interacting determinants across multiple levels of influence. Behavioral engagement may additionally influence future motivational, emotional, and contextual processes through iterative feedback relationships across socioecological levels. Reinforcement, social evaluation, and environmental response may therefore shape future behavioral engagement over time.

Collectively, these structural and operational relationships illustrate how IBSF organizes overlapping behavioral determinants within a unified multi-level analytic framework intended to support both theoretical integration and implementation-oriented behavioral research.

4 Discussion

4.1 Integration of Behavioral and Socioecological Determinants

Behavioral science and public health research have produced substantial advances in both behavioral mechanism frameworks and socioecological approaches to understanding health behavior. Behavioral synthesis efforts, including the Behavior Change Wheel and TDF, improved organization and operationalization of behavioral determinants, while socioecological and systems-oriented models emphasized the importance of contextual and structural influences operating across levels of interaction.(2, 6, 12, 18) IBSF was developed at the intersection of these traditions to support simultaneous organization of behavioral mechanisms and socioecological context within a unified analytic structure.

Existing integration efforts have improved the organization of behavioral determinants but continue to face important limitations. Frameworks such as COM-B and TDF provide valuable characterization of cognitive, motivational, social, and environmental determinants of behavior; however, they do not explicitly organize these determinants across socioecological levels of influence. Conversely, socioecological models provide a robust structure for understanding contextual influences but offer less specificity regarding the behavioral mechanisms through which behavior occurs. In practice, researchers frequently draw upon multiple frameworks simultaneously, yet these applications often lack a unified structure capable of organizing interacting determinants across both behavioral and contextual dimensions. IBSF was developed to address this gap by integrating behavioral mechanisms and socioecological context within a single analytic framework, allowing determinants to be examined simultaneously across behavioral domains and levels of influence.

A central and deliberate feature of IBSF is its treatment of conceptual overlap. Rather than approaching recurring constructs across theories as redundancy requiring elimination, IBSF interprets overlap as analytically meaningful, indicative of shared behavioral mechanisms that recur across cognitive, motivational, social, and contextual systems precisely because they reflect genuine features of how behavior operates. This reframing has practical consequences: it allows researchers to preserve theoretical nuance across frameworks without being forced to choose between them, and it positions the matrix structure as a tool for organizing complexity rather than simplifying it away. Where previous integration efforts have merged constructs by collapsing distinctions, IBSF combines by making relationships explicit. This overlap is not interpreted as evidence of theoretical redundancy, but rather as evidence that distinct behavioral traditions repeatedly identify similar mechanisms representing meaningful and recurring features of human behavioral systems operating across cognitive, social, motivational, and environmental contexts.

4.2 Operational Utility and Application of IBSF

By organizing determinants across both socioecological levels and behavioral domains, IBSF supports systematic examination of interacting cognitive, motivational, social, and environmental influences while remaining operationally usable across qualitative analysis, intervention planning, educational development, implementation-focused research, and community engagement activities.

Thus far, IBSF has been applied across multiple stages of a qualitative and implementation-oriented public health research program examining barriers to cancer clinical trial participation among rural populations. In qualitative inquiry, IBSF informed the development of semi-structured interview guides designed to ensure representation of determinants across capability, opportunity, and motivation domains and across individual, social, and environmental levels of influence (23). The framework additionally informed deductive coding structures used during thematic analysis while remaining responsive to emergent participant perspectives through inductive thematic development (23). Beyond qualitative inquiry, IBSF also informed development of educational materials, digital outreach content, implementation-oriented programming, and community engagement preparation activities. These applications included town hall planning structured around key behavioral determinants, including foundational knowledge, perceived barriers, social influences, and actionable pathways to participation. Although formal evaluation of these applications is ongoing, their breadth demonstrates IBSF's feasibility as a practical tool for bridging theoretical constructs and real-world implementation across multiple stages of public health research and practice.(23) Importantly, IBSF functioned not only as a retrospective interpretive structure but also as a prospective organizational framework guiding multiple stages of research and implementation planning, consistent with process-oriented perspectives recognizing behavioral engagement as iterative, adaptive, and contextually influenced.

Across contexts, IBSF supports systematic organization and interpretation of complex behavioral influences while accommodating context-specific adaptation. By organizing determinants within a unified multi-level structure, IBSF may support greater consistency and comparability across behavioral and implementation-focused research contexts. These applications reflect the central premise of IBSF; theoretical integration should improve not only conceptual coherence, but also practical usability across applied behavioral and public health contexts.

4.3 Extensibility

The extensibility of IBSF further supports its potential utility across interdisciplinary behavioral research contexts. While IBSF is foundationally structured around COM-B, TDF, HBM, TPB, and SEM, its matrix-based organization allows for incorporation of additional theoretical perspectives without fundamentally altering the broader framework architecture. Theories such as Classical Decision Theory, Prospect Theory, and Bounded Rationality may provide additional nuance regarding decision-making under uncertainty and constrained informational environments.(24–26)

Similarly, Social Practice Theory and Actor-Network Theory may further contextualize the influence of social systems, institutional structures, material environments, and relational networks on behavior.(27, 28) Rather than functioning as isolated theoretical silos, these perspectives may be interpreted as overlapping or interacting determinants within the broader IBSF structure.

This extensibility is particularly relevant when considering critiques regarding the complexity of motivational processes within behavioral science. While the COM-B model provides a parsimonious structure for understanding behavior through capability, opportunity, and motivation, critiques have noted that motivational processes may involve interacting reflective and automatic processes, including emotional and affective influences on behavior that are not always easily distinguishable within simplified behavioral models.(18, 29) Rather than proposing a new mechanistic theory of motivation, IBSF provides a flexible conceptual and analytic structure through which nuanced motivational processes can be organized and interpreted within a broader multi-level behavioral system.

Within IBSF, motivational determinants are distributed across reflective and automatic motivational domains while remaining connected to social influences, environmental constraints, reinforcement processes, and contextual opportunity structures.

4.4 Limitations

Several limitations should be considered when interpreting the development and current application of IBSF.

First, the consolidation of constructs from multiple theoretical frameworks into higher-order domains necessarily involves trade-offs between breadth and specificity. While this organizational approach improves interpretability and practical usability, it may reduce the granularity of distinctions that carry theoretical significance within their original frameworks. Researchers requiring fine-grained differentiation between closely related constructs, for example, between reflective and automatic motivational processes, or between perceived barriers as a cognitive evaluation versus a structural constraint, should supplement IBSF's higher-order organization with reference to the source frameworks from which those constructs are derived.

Second, IBSF was developed through iterative theoretical synthesis rather than empirical validation across diverse populations, health conditions, and methodological contexts. While the framework has demonstrated practical utility across qualitative research, educational programming, outreach development, and community engagement, and while additional applications are currently underway, the evidence base supporting its generalizability remains early-stage.(23) Initial applications of IBSF across qualitative research, educational development, outreach planning, and community engagement suggest promising utility; however, additional evaluation will be needed to assess reliability, transferability, and performance across diverse contexts.

Third, the framework selection process was iterative rather than preceded by a formal systematic literature search or consensus. While the included frameworks were selected based on their widespread application, complementary theoretical contributions, and collective capacity to support multi-level behavioral analysis, the absence of a formal search risks the exclusion of relevant frameworks. Future development efforts may benefit from a more objective evidence synthesis prior to framework identification to ensure comprehensiveness and reduce potential selection bias.

Finally, while IBSF's matrix-based architecture is designed to be extensible, the integration of additional theoretical perspectives from adjacent disciplines, including decision theory, social practice theory, and actor-network theory, remains conceptual rather than formally operationalized. Incorporating these perspectives within the existing matrix structure in a rigorous and systematic way represents an important direction for future development.

4.5 Conclusions

The Integrated Behavioral-Socioecological Framework (IBSF) was developed to address the challenge of organizing behavioral determinants across both behavioral mechanisms and socioecological levels of influence within a single analytic structure. By integrating constructs from COM-B, TDF, HBM, TPB, and SEM, IBSF provides a framework for examining interacting cognitive, motivational, social, and environmental influences on behavior while preserving meaningful relationships across existing theories. Rather than proposing a new behavioral theory, IBSF serves as an organizational approach intended to support qualitative analysis, intervention planning, implementation research, and public health practice. Future empirical evaluation across diverse populations and research contexts will be important for assessing the framework's utility, transferability, and broader application.

Abbreviations

COM-B Capability, Opportunity, Motivation and Behavior

HBM Health Belief Model

IBSF Integrated Behavioral-Socioecological Framework

SEM Socioecological Model

TDF Theoretical Domains Framework

TPB Theory of Planned Behavior

Declarations

Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Availability of Data and Materials

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

JNW conceptualized the framework structure and prepared the initial manuscript draft, including development of the accompanying diagram and table after YT proposed the concept of framework synthesis. YT gave guidance on the application section and refined the abstract. HPB and KJK collaborated on edits to the introduction section. GAG provided clarifying updates throughout

manuscript development. SB, KM, and VC conducted a final review. YT and HPB reviewed, verified, and updated citations. JNW prepared the final version of the manuscript and provided overall guidance throughout the writing process. All authors critically reviewed the manuscript and approved the final version.

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Figures

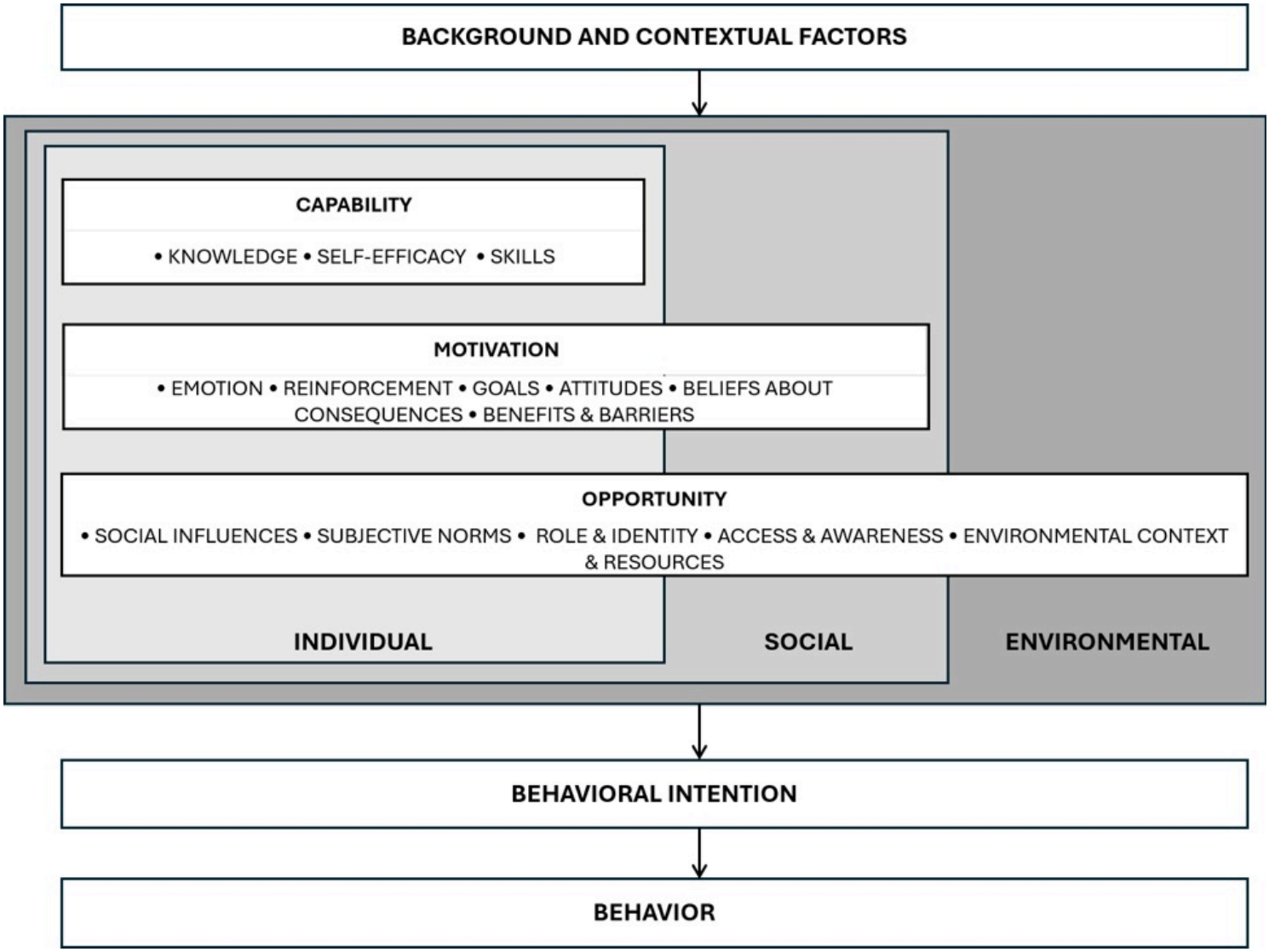


Figure 1

The Integrated Behavioral-Socioecological Framework

The IBSF framework organizes determinants of health behavior across individual, social, and environmental levels of influence aligned with the behavioral domains of capability, motivation, and opportunity. Behavioral determinants are understood as interactive, overlapping, and context-dependent across levels of influence. Table 1 provides operational detail regarding construct organization across domains and levels.

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