



Integrative Review of Developmental Behavior-Analytic Concepts

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Abstract

We reviewed five behavior-analytic concepts related to development: behavioral trap, cumulative-hierarchical learning (CHL), basic behavioral repertoire (BBR), pivotal behavior, and behavioral cusp. We searched for terminological variations of the concepts in the CAPES Journals Portal and selected for analysis 31 peer-reviewed articles written in English or Portuguese, published between 1967 and 2021, that contained the search terms in the title, abstract, or keywords and contextualized in the main text. We analysed the conventional usage of the concepts, their conceptual limitations, and the relationships among them, declared or implied, and proposed a conceptual integration of the concepts under a CHL framework, following a path indicated by other authors. We considered BBR, pivotal behavior, and behavioral cusp nonsynonymous concepts of the same logical category, referring to prerequisites for important developmental outcomes and targets of CHL-inspired interventions but defined by different effects on subsequent behavioral development. The three concepts can be conflated in a superset–subset fashion, based on the specificity of their effects: BBR consists of a broad class of behaviors that may affect subsequent learning; the subclass of BBRs characterized by far-reaching collateral effects are classified as pivotal behavior, and the subclass of pivotal behaviors whose potential effects include contact with unprecedented environmental contingencies are classified as behavioral cusps. We propose that behavioral traps be explicitly incorporated in the CHL framework, to emphasize the environmental component of the cumulative-hierarchical learning process. Our formulation seems to organize the conceptual field in a way that respects the conventional use of concepts, preserving their strengths. Regardless of the specific formulation, we believe that integrating the various development-related concepts within a cumulative-hierarchical learning framework can encourage a more proactive integration of findings, questions, and practices informed by each concept, which could lead to the mutual refinement of the corresponding conceptual and methodological frameworks, as well as new

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research questions and practical applications. In particular, we expect that explicitly incorporating behavioral traps within the CHL framework will provide a useful heuristic model to guide research on how natural environmental contingencies influence the systematic transformation of behavior across the lifespan.

Keywords Development · Behavior analysis · Behavioral traps · Cumulative-hierarchical learning · Pivotal behavior · Behavioral cusp

Introduction

For a long time, the literature characterized human development in psychology as the study of childhood. However, since 1990, the notion of development as modifications that occur throughout the life cycle (life span development) was consolidated (Gehm, 2013; Mota, 2005). Behavior analysis approaches human development from a multidimensional perspective, using the interrelationships between phylogenetic, ontogenetic, and cultural variables to explain behavioral changes throughout life (Gehm, 2013).

Despite Skinner's extensive contribution to the study of human behavior, his positions and propositions regarding behavioral development were not assembled into a single work, being spread across different texts (Bettio & Laurenti, 2016). Bettio and Laurenti (2016) systematized these contributions and conceptually analyzed excerpts about development and correlated terms from books published by Skinner between 1930 and 1980. The authors emphasized Skinner's critical opposition to a notion of development as the unfolding of information contained in genes, because such deterministic conception not only underestimates or ignores environmental influences on the developmental process but also limits the possibilities of effective intervention.

Bettio and Laurenti (2016) also highlight Skinner's criticism of the notion of fixed developmental stages, which he saw as a misconception derived from structural descriptions of behavior that often considered age as the independent variable. Although the passage of time is a necessary part of a descriptive account of developmental changes, regarding it as an independent variable does not explain why the changes occurred (Abib, 2001; Bettio & Laurenti, 2016; Mota, 2005). Such a naïve chronological perspective is conducive to explanatory fictions that attribute causal status to internal structures or inferred entities and to the pathologization of individuals whose development is at odds with the standard chronology. Tourinho and Neno (2006) summarize the essence of Skinner's formulation: "Although phylogenesis has prepared us [as a species] for certain learnings, making us sensitive to certain particular stimuli and able to emit certain responses, [idiosyncratic] contingencies of reinforcement will define the course and direction of [individual] learning" (p. 97).

Skinner warned against terms such as *milestones*, *phases*, and *stages* of development, calling attention to the role of idiosyncratic environmental contingencies in individual behavioral variability (Bettio & Laurenti, 2016; Tourinho & Neno, 2006). Skinner (1974) criticized accounts of behavioral development that focused on the topography of behavior "at the expense of other parts of the contingencies of reinforcement," and argued that any detailed record of the topography of behavioral changes—although important—"needs to be supplemented by an equally detailed

record of the conditions under which it was acquired” (p. 100). It is worth noting that Skinner’s criticisms are directed at the reductionist assumption that chronological and/or organic variables exclusively determine the behavioral regularities denoted by the terms, not the terminology itself. Provided that such assumption is explicitly rejected, it may be convenient to use terms such as milestones or stages to emphasize the existence of strong (populational) regularities in the succession of behavioral changes observed in typical human development, and to facilitate interdisciplinary communication in applied contexts.

We believe it is desirable to reconcile the necessary opposition to reductionist explanations with an appreciation of regularities discovered at different levels of analysis. It is possible to advocate for the investigation of the ontogenetic and cultural environmental circumstances under which learning occurs at the individual level (cf. Skinner, 1974, p. 100), while acknowledging the important fact that, at the populational level, there is considerable chronological regularity and predictability in the acquisition of certain behaviors, despite the relative diversity of cultural contexts and individual histories (e.g., Köster et al., 2016, about prosocial behavior; Menezes et al., 2014, for the origin of the theory of mind).

In the end, a behavior-analytic approach to development should be able to reconcile the relatively idiosyncratic character of individual learning with the undeniable (probabilistic) regularity of expected behaviors during typical development. That is to say, it must be able to tackle the fundamental developmental question of “whether [behavior-shaping environmental] contingencies vary in any systematic way across the life span, making behavior change in a correspondingly systematic way” (Rosales-Ruiz & Baer, 1997, p. 533).

Brief Overview of a Behavior-Analytic Perspective of Development

Sidney Bijou is considered a pioneer in behavior-analytic research on development (Bettio & Laurenti, 2016; Gehm, 2013). According to Tourinho and Neno (2006), Bijou argued that the only sensible notion of development refers to progressive changes in behavior-environment interactions; that is, “when we talk about development, we are referring to relational processes, in permanent transformation” (Tourinho & Neno, 2006, p. 97). At first, many experimental studies were conducted with human babies to investigate the establishment and maintenance of operant behaviors and to identify which stimuli affected the probability of occurrence of behavior classes typical of babies (Gil et al., 2012).

Bijou and Baer (1961) defined psychological development as consisting “of progressive changes in the way an organism’s behavior interacts with the environment” (p. 1). The term *interaction* emphasizes the relationships between environmental events and responses in an interdependent and continuous manner (Bijou & Baer, 1978; Vasconcelos et al., 2010). It is worth clarifying that the term *progressive* does not refer to improvement or direction of development (Gehm, 2013; Vasconcelos et al., 2010), but to the cumulative character of behavioral changes, in that the historical behavior-environment interactions probabilistically affect future interactions (Gehm, 2013).

Schlinger (2002) elucidates some key concepts. For example, although development is considered continuous and orderly, not all behavioral changes should be regarded as developmental because “such a definition would be far too inclusive” (Schlinger, 1995, p. 42). In this sense, Baer and Rosales-Ruiz (1998) and Rosales-Ruiz (2003) mention that if orderly, predictable, and systematic behavioral changes are considered developmental, it is essential to investigate if and how society systematically arranges contingencies for them. This position is congruent with the emphasis given by Skinner on environmental contingencies in explaining behavioral changes (cf. Bettio & Laurenti, 2016).

Since the 1960s, a variety of concepts have been proposed to deal with different aspects of behavioral development from a behavior-analytic perspective. Regarding relevant environmental conditions, Baer and Wolf (1967) explored how entering a peer group could favor learning and persistence of some behaviors due to *trapping* in a natural community of mutual reinforcement contingencies. The authors coined the concept of *behavioral traps* while examining the particular case of the preschool as “a community of reinforcement contingencies which will shape and maintain an ever-increasing repertoire of social behavior and will put that behavior under the control of peers” (p. 15). The behavioral change needed to enter the social trap is relatively simple (e.g., start walking; approach another child), but it gives access to natural contingencies of social reinforcement that will potentially shape and maintain a variety of new social skills.

Staats (1968, as cited in Staats, 1996; Staats et al., 1970) proposed the concept of *cumulative-hierarchical learning* (CHL) to highlight the role of relatively simpler behavioral changes as necessary prerequisites for learning increasingly complex behavioral changes. In the concept of cumulative-hierarchical learning, behavioral development is considered a cumulative and incremental process (Hixson et al., 2011), so that there would be a learning hierarchy of skills in achieving important competencies, such as language, emotion, and sensory-motor skills (Staats, 1996). The concept of cumulative-hierarchical learning presupposes the subordinate concept of *basic behavioral repertoires* (BBR), skills that are of special importance for their generative impact on future learning (Hixson et al., 2011). In behavioral interventions, the CHL framework helps identify BBR prerequisites for the potential emergence of complex repertoires (Tourinho & Neno, 2006).

Likewise, Koegel and Koegel (1988, as cited in Rosales-Ruiz & Baer, 1997) proposed the concept of *pivotal behavior* for behavioral changes that have far-reaching collateral effects on future learning. For Bosch and Hixson (2004), “pivotal areas of functioning” or pivotal responses are behaviors that directly affect other behaviors, such as motivation or self-initiation.¹ The concept is prevalent in the literature and intervention in children diagnosed with autism spectrum disorder (ASD),

¹ In the context of intervention with severely disabled individuals, self-initiation refers to the participant initiating tasks and activities (Shukla et al., 1995) or verbal interaction with other people (Bosch & Hixson, 2004; Koegel et al., 2003) with reduced need of directive behavior from support persons. The authors give as examples a participant’s behavior of taking her clothes to the laundry or sitting at the table for meals; and as examples of verbal interaction the behavior of asking questions and using pronouns and words that direct the interlocutor’s attention.

because teaching this population a few strategically selected skills can positively affect multiple developmentally relevant skills. For example, teaching students a few appropriate communicative behaviors (such as eye contact and facial expressions) can modify multiple abnormal social behaviors (Koegel & Frea, 1993). According to Koegel et al. (2003), verbal and nonverbal social initiations (such as question-asking) may be considered pivotal for children with autism because “they appear to result in widespread positive changes in a number of areas” (p. 134).

Rosales-Ruiz and Baer (1997) proposed the concept of *behavioral cusp* to describe behavior that, in addition to producing immediate discrete consequences, also allows the individual to contact new environments that can foster the transformation of the behavioral repertoire through the learning of new behavior, expansion of stimulus control of preexisting behavior, contact with new reinforcers, etc. (Rosales-Ruiz & Baer, 1997). The authors explicitly relate behavioral cusps to the responses needed for entering Baer and Wolf’s (1967) behavioral traps: “[t]o the extent that these traps shape behavior beyond the entry responses, and to the extent that those behaviors are important to someone at some time, the entry responses are cusps” (p. 536). Like pivotal behavior, the concept of behavioral cusps provides a template for identifying behavioral prerequisites for further behavioral development, in particular responses that will expose the individual to unprecedented environmental contingencies of reinforcement conducive to developmentally important learning. Some examples are speaker and listener behavior, responding by exclusion, play skills, and creative behavior (e.g., Alcantara Gil, 2019; Charlop et al., 2018; Greer & Keohane, 2005; Neves Filho et al., 2019).

Although some concepts are similar and even explicitly associated with each other in the literature—e.g., pivotal behavior and behavioral cusps are both described as strategic targets of interventions (e.g., Rosales-Ruiz & Baer, 1997)—their interrelationships are eclipsed by terminological and procedural specificities of their different application domains, and there have been few attempts to integrate the various concepts into a more cohesive conceptual framework (e.g., Smith et al., 2006). Smith et al. (2006) suggest that “synthesizing existing theoretical research and knowledge on CHL and behavioral cusps” can contribute to introducing new hypotheses and operations in traditional behavior modification interventions whose single-subject, single-behavior strategies do not yet incorporate reciprocal, cumulative, and hierarchical features of behavioral development.

In this review we aimed to contribute to this theoretical synthesis, seeking to integrate the concepts of behavioral traps, cumulative-hierarchical learning, basic behavioral repertoires, pivotal behaviors, and behavioral cusps. Even a cursory glance at the literature reveals that those concepts differ greatly in terms of context and purpose, specificity, operationality, and applicability. There are also notable differences in their evidential base: as extremes, the concepts of pivotal behavior and behavioral cusps have been informed by decades of basic and applied research (e.g., Forbes et al., 2020; Greer, 2020; Pohl et al., 2020; Verschuur et al., 2014) whereas the concept of behavioral traps seems to rely mainly on guiding hypothesis and anecdotal reports. Behavioral cusps and behavioral traps also illustrate important differences in emphasis, with the former focused on behavior that gives access to new learning opportunities, and the latter focused on the social environment in

which new learning is possible. The conceptual and methodological particularities discourage any attempt to reduce concepts to one another, discard concepts or hastily choose one concept over others.

Furthermore, superficial convergences already noted in the literature encourage the hypothesis that at least some concepts can usefully complement each other in a broader conceptual milieu. Assuming that none of the concepts are irrelevant or redundant, we are especially interested in exploring their overlapping, complementary, and hierarchically related aspects to examine the role each concept could play in an integrative conceptual narrative. In particular, we aimed to: (1) summarize the conventional use of the concepts; (2) examine their logical relationships in terms of overlap, complementarity, and hierarchy; and (3) propose a tentative conceptual integration based on the identified relationships. We hope that integrating the various concepts under a cumulative-hierarchical learning perspective will provide a helpful heuristic for attempts to reconcile the idiosyncrasy of behavioral changes at the individual level with the relative generality and chronological predictability of developmental changes at the population level.

Method

We conducted an integrative review of the literature. The sources were articles available online on the CAPES² Journals Portal indexed databases (*Portal .periódicos. CAPES*). This virtual library collects several journals and databases and gives free access to national and international scientific publications to teaching and research institutions in Brazil.

Procedure of Search and Selection of Sources

Choosing Keywords

A preliminary survey of terminological variations of the concepts covered in this review was carried out based on: (1) texts already known by the authors; (2) texts recommended by fellow experts in the field; (3) vocabulary present in the references of the consulted texts. Table 1 shows the keywords chosen for search in the sources.

Definition of Selection Criteria

Inclusion Criteria Only articles published in peer-reviewed journals between 1967³ and 2021, written in English or Portuguese, were selected for analysis. Results containing the corresponding search descriptor in the title, abstract, or keywords were selected for further examination. An article was included if it presented at least one

² CAPES stands for *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*, the Brazilian Agency for the Improvement of Higher Education Personnel.

³ Year of the publication introducing the oldest concept analyzed, behavioral trap.

Table 1 List of keywords in English and Portuguese corresponding to the concepts of behavioral traps, cumulative-hierarchical learning, pivotal behaviors, and behavioral cusps

Concept	Keywords in English	Keywords in Portuguese
Behavioral Traps	“Behavioral traps” “Behavioural traps” “Behavioral trapping”	“Armadilhas comportamentais”
Cumulative-Hierarchical learning	“Cumulative-hierarchical learning” “Basic behavioral repertoires”	“Aprendizagem hierárquica” “Aprendizagem hierárquica cumulativa”
Pivotal Behaviors	“Pivotal behavior” “Pivotal skill” “Pivotal social skills”	“Comportamentos pivotais” “Comportamentos-chave”
Behavioral Cusps	“Behavioral cusp” “Behavioral cusps” “Developmental cusp” “Verbal developmental cusp” “Behavioral developmental cusp”	“cúspide comportamental” “cúspide desenvolvimental” “cunha comportamental” “salto comportamental” “ápice comportamental” “ápice desenvolvimental” “cusp comportamental”

of the following elaborations: definition of the concept under analysis; arguments about scope, role in development, practical applications, and/or conceptual limitations of the concept; theoretical approximations with other concepts.

Exclusion Criteria We excluded from our research editorial publications, book chapters, book reviews, salutations, interviews, homages, and articles with the search descriptors only in the references. We also excluded articles that only mentioned the terms, even though they fulfilled the preliminary selection criteria or those whose subject was not related to the study of development (e.g., dental cusp in odontology studies). To restrict the latter case, we used the *Subject/Topic* (in Portuguese *Assunto*) option of the search engine’s filtering tool.

Search in the CAPES Journal Portal

We accessed the CAPES Journals Portal from the *Universidade Federal do Pará* (a public university maintained by the Brazilian government in the State of Pará, Brazil) and conducted the search for publications using the set of keywords for each concept shown in Table 1. We used 25 keywords in total, including terms in English and their corresponding terms in Portuguese. The use of quotation marks in the search for keywords in the database aimed to favor the occurrence of specific word combinations. Otherwise, the results would include fragments of the search terms, making the survey more unspecific and exhaustive. Additional resources available in the CAPES portal used to restrict the findings were: (1) inclusion of topics related to the terms, and (2) exclusion of topics unrelated to the study when presented by the search mechanism. For example, the topics *psychology*, *ecology*, *clinical trials*, *developmental disabilities*, and *behavior therapy* were some of the topics included

as filters. Regarding the excluded topics, some examples are *spatial scale*, *forest fragmentation*, *population decline*, and *mathematical models*. The number of results indicated by the search mechanisms after the application of the filters was recorded.

Download of Search Results

We saved the archives available for download, excluding only possible repetitions of results for keywords, and later organized them into folders corresponding to the used search term.

Application of the Inclusion and Exclusion Criteria

In this step, we excluded editorials, books, book reviews, or articles published outside the analyzed period. We kept documents published within the period of interest, written in English or Portuguese, and published in peer-reviewed journals.

Selection of Articles Containing the Terms in Specific Sections

We selected only documents with the exact search terms in the title, abstract, or keywords.

Selection of Articles Contextualizing the Terms

We divided the remaining articles into those that mentioned the terms and those that contextualized the terms. For example, articles that only presented the term *pivotal behavior* to describe a behavior under investigation were disregarded, whereas articles that defined, criticized, and/or related the term to other concepts were selected for analysis.

Reading of the Selected Articles

After excluding repeated documents between the categories, the selected articles were thoroughly read.

Systematization of the Material

We used an Excel spreadsheet to record the author names, the title of the article, publication year, journal, keywords, objectives, article type (theoretical or empirical), passage in which the term or its variation is mentioned in the article (similar to the design adopted by Bettio & Laurenti, 2016), and whether it interfaced with other concepts/areas and variations of the descriptor. The passages containing the descriptions, the abstract of the text, and comments about the use of the concepts were cataloged in Word documents for each article.

Data Analysis

We based the characterization and discussion of the behavior analytic concepts related to development on quantitative and qualitative analyses. We quantitatively analyzed the number of results for each step of the selection procedure and the temporal distribution of selected publications in tables. We carried out the qualitative study considering the uses of the concepts in the chosen texts, based on the following categories of analysis: definition, the scope of the concept, role in development, practical applications, conceptual limitations, and interface with other concepts under investigation.

Results and Discussion

Table 2 (see Appendix) shows the number of articles in each step of the selection procedure for all keywords. The sum of the results from the search in the CAPES Journals Portal for all concepts was 646. After eliminating repetitions in the keyword results, it was possible to download 531 files. After applying the criteria described in each step, 31 articles remained for analysis. These articles are marked by an asterisk in the reference list. The search for terms in Portuguese resulted in only two recorded occurrences for the terms *cunha comportamental* and *ápice comportamental*. However, only one of those articles met the inclusion criteria. There was a prevalence of terms related to behavioral cusps and pivotal behaviors among the articles selected for analysis. The results will be presented at first considering the individualized analysis by concept, based on texts selected for contextualizing the concept under investigation. We will first present the analysis of articles selected for each concept, focusing on the conceptual usage, regarding definition, scope, role in development, practical applications, conceptual limitations, and interface with other concepts under review. Next, we will discuss the relationships identified among the concepts, from which we will propose a conceptual integration.

Analysis by Concept

Behavioral Traps

Of the 65 results initially found in the survey of the CAPES Journals Portal, only two articles were selected for analysis, one published by Kohler and Greenwood in the journal *The Behavior Analyst* in 1986 and the other published by McConnell, Sisson, Cort, and Strain in *The Journal of Special Education* in 1991. The first is a bibliographic review directed to “natural contingencies of reinforcement” and the second reports the effects of training social abilities and management of contingencies on mutual interactions in preschool children. Neither article mentions other concepts.

Beyond the search term (behavioral traps), Kohler and Greenwood (1986) list 20 variations used as analogous (see Table 3 in Appendix), which include the terms used by McConnell et al. (1991). The occurrence of so many variations in the text of Kohler and Greenwood may be explained by their objective of listing relevant characteristics for identifying and analyzing behavioral traps. The authors mention that the notion of behavioral traps precedes that of Baer and Wolf (1967) because Patterson et al.'s (1965, as cited in Kohler & Greenwood, 1986), and Ayllon and Azrin's (1968, as cited in Kohler & Greenwood, 1986) propositions converged with Baer and Wolf's (1967) proposal, in examining social behaviors maintained by social interactions.

The terms related to behavioral traps seem to be used consistently among the authors despite the difference between their publication years. In general, the concept of behavioral traps was treated in the analyzed articles as a behavioral technology that is useful for the maintenance and generalization of newly acquired behaviors in contexts that are external to the intervention. However, there is a strong need for empirical studies that focus on criteria for identifying traps and on systematizing the data on behavioral change attributed to behavioral traps (Kohler & Greenwood, 1986). In their analysis, Kohler and Greenwood focused on "natural contingencies of peer reinforcement," i.e., how to identify the *entrapment* of behaviors by social stimuli that are not under the researcher's control, including social contingencies provided by other people and by nonsocial stimuli.

Kohler and Greenwood (1986) present five types of empirical evidence useful for identifying and analyzing behavioral traps in natural contexts. The first type of evidence considered by the authors consists of showing generalization between behaviors or environments, as generalization allows the evaluation of trapping as an explanatory hypothesis. The second type of evidence would be the maintenance of the new behavior after removing the stimuli used in the intervention or identified in the context of generalization. The follow-up data will clarify if the conditions under which generalization occurred are consistent with the entrapment hypothesis. The third type of evidence refers to the temporal covariation between the behavior and the natural contingencies of reinforcement, in particular, to which naturally occurring social stimuli coincide with the observed behavior. The fourth type of evidence is described as the most inclusive regarding the occurrence of behavioral traps, as it involves analyzing whether the social stimuli are functionally related to the observed behavior and whether, through experimental manipulation, other individual behaviors are also affected. Concerning the data generality, systematic replication is the fifth necessary type of evidence, which would require the application of social stimuli contingently to other behaviors and in different contexts.

Identifying trapping contingencies can also affect the learning of appropriate repertoire in unplanned contexts (Kohler & Greenwood, 1986). The acquisition and maintenance of appropriate behavior and the prevention of disruptive behavior independently of a researcher or therapist's interventions, are desired results for clinical intervention, especially with children with behavioral impairments or atypical development.

Cumulative-Hierarchical Learning

There were 64 results for the searches of this category, of which 6 articles remained for analysis. Only three articles mention some of the other concepts or relate them to the concept of cumulative-hierarchical learning: Bosch and Hixson (2004), Hixson (2004), and Smith et al. (2006). These are also part of the sample of articles on behavioral cusp. Most articles ($n = 5$) were published between 2000 and 2006. Table 4 (see Appendix) shows the variations for the search terms of this category identified in the selected texts.

The literature uses the term *cumulative-hierarchical learning* (CHL) in reference both to a set of procedures (Bosch & Hixson, 2004; Smith et al., 2006; Staats, 1994) and a heuristic model (Hixson, 2004). It applies to the cumulative and incremental effects of previous learning on subsequent learning. Using cumulative-hierarchical learning involves describing learning as a cumulative process in which there is interdependence between the current behavior, behavioral history, and basic behavioral repertoire. Or, as defined by Staats (1975, as cited in Bosch & Hixson, 2004), as a principle describing the process in which complex behaviors arise from the interaction between simpler behaviors on a long-term time scale. Smith et al. (2006) refer to CHL as a “family of normative behavioral practices and procedures” and state that “the question of how higher-level behavioral patterns and structures can emerge from interactions among a set of lower-level actions” is central to CHL (p. 224).

From Smith et al. (2006), one can assume that CHL refers to the emergence of more complex behavioral patterns from simpler interactions. Still, the hierarchical aspect is not evident in the descriptions and diagrams presented by Staats (1994) and Hixson (2004). Staats’s (1994, p. 107) formulation—in which the interaction history that led to the occurrence of basic behavioral repertoires (BBR) will act, together with the current environment, in the determination of the new behavior—does not contribute to clarifying the learning hierarchy.

The subordinate concept of BBR is described as referring to behaviors that allow learning of subsequent behaviors (Bosch & Hixson, 2004, p. 245) or as necessary repertoires for subsequent learning (Lund, 2001, p. 188; Staats, 1994, p. 106). General repertoires like imitation and naming are mentioned as important BBRs (Lund, 2001; Staats, 1994). The concept of BBR is offered as both a dependent variable and an independent variable, in the sense that the current behavioral repertoire not only depends on the organism’s history of interactions (like any operant learning) but also acts with the current contingencies for new behaviors to appear (Lund, 2001; Staats, 1975, as cited in Hixson, 2004; Staats, 1994). Lund (2001) argues that the concept “surpasses the three-term and four-term contingency and incorporates the existing repertoire of the child as an independent variable in the skill-building process.”

Holth (2003) considers the concept of BBR useful in planning behavioral sequences for academic intervention but criticizes the lack of clarity of the concept, the phenomena encompassed by it, its effects, and the causal status commonly attributed to BBR (an aspect also criticized by Hixson, 2004). Basic behavioral repertoires are variously described as “stimulus-response constellations,” as “composed

of behavior” but “different from the displayed behavior itself,” as “potential for action.” A BBR can be seen as a heterogeneous set of behaviors related to an abstract competence, but it is challenging to identify the appropriate unit of analysis. For example, Lund (2001) characterizes a broad competence domain such as “understanding the implications of social behavior” as a “macro-skill” consisting of “a constellation of BBRs.” It is not obvious why it is a *macro-skill* consisting of BBRs rather than a BBR itself. Statements such as “numerous individual components combine to yield a BBR” and “the importance of the elements in the BBR as prerequisites for the acquisition of subsequent skills” (Lund, 2001) eventually shift the focus from the abstraction BBR to the underlying discrete behaviors. But the absence of an explicitly operational definition of what counts as *components* or *elements* leaves the reader with the burden of resolving the conceptual confusion. In some articles, the conceptual confusion becomes even more problematic due to the approximation with other concepts and even the use of some as equivalents, such as the concepts of basic behavioral repertoires and behavioral cusps in Hixson (2004).

Analyzing an example by Staats (1996, as cited in Holth, 2003), Holth identifies two classical conceptual problems: category mistake and circularity. Staats argues that the BBR—a higher-level concept presupposing behavior as a subordinate category—can be a cause of behavior (an event of the subordinate category). Such category mistake makes circularity inevitable because the same terms are used to describe “both the BBR and the performances supposedly caused by that BBR” (Holth, 2003, p. 310). That seems to be the case when Staats (1996) illustrates how a BBR would be a direct cause of behavior: after stating that attending to what an adult says when requested is a part of the “verbal-motor repertoire of attending” (a BBR), Staats explains that “a child without that [part] of the repertoire will not attend, will not experience the stimuli, and will not learn.”

However, the excerpt seems to allow an alternative, somewhat less problematic interpretation. Although Staats apparently begins with a category error by saying that BBR causes behavior, the rest of the argument seems to imply that attending to what an adult asks for is an element of the heterogeneous category of behaviors labeled verbal-motor repertoire of attending. That is to say, the verbal-motor repertoire of attending is composed of several behaviors, but not exhibiting the specific behavior highlighted by Staats implies that the child “will not experience the stimuli, and will not learn.” Despite the confusing language, a benevolent interpretation would be that the higher-level BBR—taken as an abstract competence, a *potential for action*—cannot be said to exist in the absence of one of its components; and subsequent learning that would be “caused”⁴ by the BBR cannot happen. Insofar as a potential for action will only be inferred from the systematic demonstration of the action, the targets of CHL/BBR-oriented interventions will necessarily be discrete behaviors. It seems that defining BBR as “actual stimulus-response constellations that have to be stipulated” (Staats, 1996, p. 193) is a fancy way of saying that the intended competency involves learning a set of different and related behaviors.

⁴ Considering that BBR is said to serve as an independent variable with respect to subsequent learning (e.g., Lund, 2001), describing BBR as a “cause” of behavior may imply that the acquisition of behavior indicative of a BBR is functionally related to the acquisition of other behaviors.

In the end, even if an intervention aims to teach a collection of behaviors, the intervention targets will be the component behaviors. Referring to discrete items and collections of items by the same term does not seem to be a problem. It is a common practice when we talk about operants and responses, for example. What must be avoided is fallacious reasoning when relating a category and its elements. In this regard, Holth (2003) argues that the frequent use of BBRs as a causal explanation, despite its vague definition and use, should serve as an alert for the inconsistency of the concept. Although Staats mentions BBRs as independent variables, Holth argues that they are not subject to manipulation, which hinders their assessment and application. One way of avoiding conceptual confusion and discouraging fallacious reasoning would be to explicitly shift the focus of the definition to the component behaviors of the heterogeneous behavioral classes identified as BBR. Such revision seems to converge with Holth's (2003) claim that "a version of the concept of basic behavioral repertoires (BBRs) may still be important" in the context of specifying the prerequisites for establishing complex skills (p. 312). Holth (2003) points out that, despite the conceptual confusion, the interdependence between repertoires implied by the concept of BBR may be relevant to plan some teaching sequences in academic contexts and, consequently, to teach complex behaviors.

Hixson (2004) proposes an alternative model that excludes BBR and raises questions about the very necessity of the concept of CHL as initially represented by Staats. However, it seems relevant to consider that Staats's (1975, as cited in Bosch & Hixson, 2004) characterizes CHL as a principle that indicates that "much of human behavior is acquired in learning processes of great duration and complexity" (p. 63), and that Smith et al. (2006) consider that the hierarchical aspect of the term refers to the increase in complexity of the repertoire. It may be possible to see CHL as an organizing principle that locates relevant operant learning in a behavioral stream of increasing behavioral sophistication. That is to say, development as an extended process involves behavior that becomes more complex through the continuous interaction between organism and environment, with interdependence between new and previous learnings.

Pivotal Behavior

The search for the terms of this category resulted in 324 results, from which 13 articles were selected for analysis: 6 for pivotal behavior, 5 for pivotal skills, and 2 for pivotal social skills. Among the selected articles, most ($n = 10$) were published after the year 2000. Three publications occurred in 2015, two of which were identified in the search for *pivotal behavior* and one in the search for *pivotal skill*. Only Bauer and Jones (2014) relate pivotal behavior with another analyzed concept (behavioral cusp). Table 5 (see Appendix) shows the variations for the search terms of this category identified in the texts.

Pivotal behavior is most often defined as behavior considered central to development because it indirectly (collaterally) affects behaviors that were not directly targeted by the intervention (Bauer & Jones, 2014; Charman, 2003; Chiu et al., 2017; Hupp & Reitman, 2000; Karaaslan & Mahoney, 2015; Mahoney et al., 2007; Mundy & Crowson, 1997; Smith et al., 2015; Smith et al., 2016; Tseng, 2015). The

repercussion of intervening in pivotal behaviors is also mentioned, especially concerning early intervention (Mahoney & Perales, 2005) and intervention for children with autism or developmental delay (Mundy & Crowson, 1997). Behaviors considered central to development often mentioned as of interest to the researchers are: attention, task engagement, persistence, cooperation, control of emotion, joint attention, independent initiation of social interactions, and self-instruction (Charman, 2003; Karaaslan & Mahoney, 2015; Mahoney & Perales, 2005; Mundy & Crowson, 1997; Smith et al., 2015; Smith et al., 2016; Tseng, 2015).

Mundy and Crowson (1997) discussed individual differences in the developmental changes that follow the acquisition of pivotal behavior and proposed expanding the concept to encompass a readiness for learning in other domains (Mundy & Crowson, 1997, p. 666). Considering that acquisition of a pivotal behavior does not promptly generate other repertoires, the authors argue that this could reflect previous individual differences in early interventions, offering an alternative hypothesis about why some behaviors are central for some children but not for others.

Some authors argue that the promotion/acquisition of pivotal behaviors would favor not only the emergence of acceptable, socially desirable behavior but also promote a decrease in the frequency of disruptive behaviors (Charman, 2003; Koegel & Frea, 1993; Mahoney et al., 2007; Tseng, 2015).

Investigations conducted by the research group coordinated by Robert Koegel and Lynn Koegel about how to increase the efficacy of interventions for children with autism spectrum disorder (ASD) led not only to the identification and proposition of behaviors that are central for development but also to the development of evidence-based intervention packages known collectively by the acronym PRT: pivotal response treatment, pivotal response training, or pivotal response teaching; the first two being more related to clinical interventions and the third to interventions in a school context (Karaaslan & Mahoney, 2015; Mahoney et al., 2007).

The concept of pivotal behaviors appeared mostly about the impacts of acquiring behaviors specifically related to motivation and engagement (Koegel & Koegel, 2012), especially in the context of interventions in ASD. Some behaviors considered central to development, identified in the analyzed articles, were: joint attention, task engagement, cooperation, emotion control, independent initiation of social interactions, and self-instruction. An exception was the use of pivotal behaviors by Bauer and Jones (2014) when considering exploratory motor behavior as an important skill for development and addressing how the acquisition of this type of behavior occurs in typical and atypical development (in particular, of children with Down syndrome).

Behavioral Cusps

We obtained in the initial search 194 results for the search terms related to this concept, from which 18 articles were selected for analysis. Nine articles discussed behavioral cusps relative to other concepts. The occurrences encompass the period between 2001 and 2021. The largest number of publications ($n = 3$) occurred in 2004, discarding repetitions. Table 6 (see Appendix) shows the variations for the search terms of this category.

In the selected texts, behavioral cusps is recurrently presented according to Rosales-Ruiz and Baer (1997), as behavior change that occurs throughout development and allows access to new interaction contexts, producing impacts beyond the behavior change itself (Barton & Ledford, 2018; Bosch & Fuqua, 2001; Brogan et al., 2021; Fogaça et al., 2019; Greer, 2020; Greer et al., 2011; Hixson, 2004; Ingvarsson et al., 2007; Morgan et al., 2021; Stokes et al., 2004). These impacts are frequently described as access to new contingencies, new stimulus control, and new reinforcing and punishing stimuli. Here, the emphasis on the word *new* is relevant because the aspects of the organism–environment interaction that are considered important were not possible or were not available before the occurrence of the cusp and allow the individual’s repertoire to be expanded. Smith et al. (2006) emphasized the innovative effect on subsequent learning in an analogy between a behavioral cusp and a *killer app*, a name attributed to software applications whose launching renders the previous applications of the same category obsolete. In comparison, the occurrence of a cusp is considered a significant change in the individual’s behavioral repertoire, expanding and replacing aspects of the previous repertoire.

In general, behavioral cusps are behaviors relevant to development resulting from organism–environment interactions, and can be explicitly taught (Bosch & Hixson, 2004; Greer & Du, 2015; Robertson, 2015). In line with Rosales-Ruiz and Baer (1997), some articles mention that although certain behavioral changes are behavioral cusps for most people, there are also idiosyncratic changes that should be viewed as behavioral cusps (Bosch & Hixson, 2004; Smith et al., 2006). Bosch and Fuqua (2001) point out that behavioral cusps are defined by their effects, similar to the definition of reinforcers; so the verification of potential cusps follows a similar logic. The evaluation of potential cusps will involve two extrapolations by the intervener: (1) that a behavioral change that functions as a cusp for most people can be a cusp for a specific individual (i.e., it will result in the desired changes); and (2) that the expected repercussions will be maintained by extant contingencies.

Bosch and Hixson (2004) state that cusps can be simple or complex behaviors, and argue following Rosales-Ruiz and Baer (1997) that the cusp can be a behavior or a class of behaviors (Bosch & Hixson, 2004, p. 248). Considering that the definition of operant behavior itself assumes a class of functionally related behaviors, the characterization of the cusp as a behavior or a class of behaviors seems innocuous at first glance. Emphasizing that a cusp can be a class of behaviors seems to imply that, in some cases, the cusp is a heterogeneous collection of behaviors (e.g., making eye contact *and* displaying appropriate facial expressions).

Smith et al. (2006) argue that establishing behavioral cusps should be a priority in clinical interventions and the design of academic curricula. The notion of behavioral cusp prompts behavior analysts to consider the individuals as well as the people with whom they interact while planning to promote access to new contingencies, reduce disruptive behaviors, and promote quality of life. Hixson (2004) presents a table with examples of behaviors that are considered behavioral cusps that promote the development of socially desired repertoires and socially undesired cusps from the analysis of the results of published studies.

According to Fogaça et al. (2019), studies published in Portuguese use the concept of behavioral cusp in a variety of contexts: analysis of play behavior (de Rose & Gil, 2013, as cited in Fogaça et al., 2019); identification of behavioral cusps from intervention seeking to teach instruction-following through play (Bezerra et al., 2013, as cited in Fogaça et al., 2019); development of self-controlled responses via the tolerance to delayed reinforcer procedure, which has important repercussions for the coexistence of children in the home and school context (Haendel & Alvarenga, 2018, as cited in Fogaça et al., 2019); development of responding by exclusion as a behavior that is socially validated and provides access to new reciprocal contingencies (Alcantara Gil, 2019).

The term “verbal behavioral developmental cusp” appears in the context of research on verbal development informed by the verbal behavioral development theory (VBDT; Greer, 2020; Greer & Du, 2015; Greer et al., 2011; Morgan et al., 2021). Greer (2020) and Morgan et al. (2021) highlight “bidirectional naming” (BiN)⁵ as a verbal developmental cusp that, when present, “favors incidental language learning.” Morgan et al. (2021) examine the role of BiN in the emergence of relational repertoires, such as those studied from the stimulus equivalence paradigms (e.g., Sidman, 1994, as cited in Morgan et al., 2021), naming theory (e.g., Horne & Lowe, 1996, as cited in Morgan et al., 2021) and relational frame theory (RTF; e.g., Hayes et al., 2001, as cited in Morgan et al., 2021). Morgan et al. (2021) argue that speaker-as-own-listener operants like “self-talk conversational units, say and do correspondence, bidirectional conversational units between individuals” are needed for the demonstration of more complex emergent stimulus control, such as “arbitrary derived relations and combinatorially entailed relations.” The authors considers BiN a verbal developmental cusp because “when children attain the stimulus control for BiN they learn at different rates and through new types of instruction” (Morgan et al., 2021, p. 385).

Empirical research on the VBDT tradition seeking to identify the prerequisites for the initial development of BiN and other verbal behavioral cusps has pointed to conditioned reinforcement both for observation responses and for the correspondence between observed stimuli and speech. Greer (2020) discusses the acquisition of conditioned reinforcers as a cusp—the reinforcement cusp—for its generative effects. For example, “establishing of reinforcement for observing voices leads to stimulus control for discriminating phonemic stimulus and eventually to listener responses to spoken instructions or word object relations” (p. 550). This line of research has identified a “range of critical cusps in a developmental trajectory” that can be divided into four categories: “(1) preverbal, foundational cusps, (2) listener cusps and speaker cusps in the developmental period when they are independent, (3) the joining of the listener and speaker, and (4) the joining of print to listener and speaker cusps” (Greer, 2020, p. 550).

⁵ According to Morgan et al. (2021), the term *bidirectional naming* refers to the integration between listener and speaker repertoires and, in the context of VBDT, it is identified as “one of the speaker-as-own-listener cusps that are bidirectional operants . . . demonstrated when in the individual behaves as listener to their own speaker behavior” (pp. 368–369).

Bosch and Fuqua (2001) extended the criteria for the verification of cusps to include, in addition to “(a) access to new reinforcers, contingencies, and environments; (b) social validity”—both proposed by Rosales-Ruiz and Baer (1997); “(c) generativeness; (d) competition with inappropriate responses; and (e) number and relative importance of people affected” (Bosch & Fuqua, 2001, p. 123). The first criterion refers to whether the target behavior will possibly expose the organism to new reinforcers, contingencies, or environments. The criterion of social validity refers to social demands from the social group, i.e., one must consider whether the behavior is considered important in the broad context, which will be critical for the maintenance of desired and undesired behaviors (such as adequate hygiene after defecation, explored by Stokes et al., 2004). In evaluating and prioritizing target behaviors, one must also consider the potential of recombination and its impact on abilities not directly trained, which corresponds to the criterion of generativeness. To Bosch and Fuqua (2001), the importance of a cusp is directly proportional to its competition with inappropriate responses, because they can remediate or avoid the worsening of disruptive behaviors (as discussed by Robertson, 2015). The role of other people in the acquisition and maintenance of behaviors is critical when considering how many people can be affected by the cusp as well as its importance to the learner, so intervention should prioritize behaviors that benefit people close to the target individual whenever possible.

Bosch and Fuqua’s (2001) criteria to evaluate whether a target behavior can be considered a cusp (Greer et al., 2011; Greer & Du, 2015; Ingvarsson et al., 2007; Robertson, 2015; Stokes et al., 2004) are considered useful together with other evaluation methods, such as interviews and behavioral observation (Bosch & Hixson, 2004) and as relevant in prioritizing target behaviors (Hixson, 2004; Robertson, 2015; Smith et al., 2006). A behavior will be considered a behavioral cusp if it meets at least one of the criteria of Bosch and Fuqua (2001; Bosch & Hixson, 2004), of which social validity and exposure to new interaction possibilities seem to be the most decisive. The more criteria a cusp meets, the more important it will be (Bosch & Fuqua, 2001)

Robertson (2015), Fogaça et al. (2019), and Brogan et al. (2021) discuss the potential of disruptive behaviors⁶ to serve as behavioral cusps, a possibility foreseen since the proposition of the concept by Rosales-Ruiz and Baer (1997), but little explored. Robertson (2015) considers Bosch and Fuqua’s (2001) criteria in detail and argues that disruptive behavior may be a behavioral cusp if its acquisition favors contact with new reinforcing contingencies that favor its occurrence over appropriate alternative behavior and “shape behavior in further detrimental ways, triggering their own problematic consequences that would not have occurred had the individual never begun using problem behavior” (p. 485). The author also explores the role of behavioral traps in promoting such disruptive behavioral cusps, a conceptual relationship we will discuss further below. Fogaça et al. (2019) converge with Bosch and Fuqua (2001) and Robertson (2015) when considering the competition

⁶ Although Robertson (2015) uses the term *problem behavior*, we prefer *disruptive behavior* for behaviors that can harm the individual, restrict learning opportunities, or harm caregivers or interveners.

with inappropriate responses within the scope of social skills, arguing that inappropriate responses occur on a continuum of severity, just as behavioral cusps have a continuum of relevance, based on Rosales-Ruiz and Baer's (1997) and Bosch and Fuqua's (2001) criteria. Brogan et al. (2021) also point out that some behavioral changes may function as undesirable cusps that expose the individual to the possibility of acquiring other socially inappropriate responses. For example, they highlight how antisocial behaviors in childhood lead to a cumulative effect of noncompliance behaviors or disrespectful responses directed towards teachers or other authority figures, proximity to peers who interact similarly, and consequent withdrawal from peers who show more prosocial behaviors.

In summary, according to Bosch and Fuqua (2001), the concept of behavioral cusp can contribute to the selection and prioritization of target behaviors, as well as serve as a favorable argument for the establishment of behaviors that at first may seem insignificant but that can have a great impact on the learner. The authors recognize that the critical evaluation of the behaviors to be established in a person's repertoire is already routinely performed by behavior analysts and argue that the concept of behavioral cusp can make such evaluation more systematic. The clarification of the criteria to determine whether a behavior is a cusp not only strengthens the use of the concept but can also contribute to increasing the effectiveness and, as a result, the acceptance of the proposed behavioral interventions (Bosch & Fuqua, 2001).

Relationships among the Concepts

Eight of the 31 articles analyzed brought together more than one of the concepts. We identified different degrees of approximation among the concepts in the selected articles, in that some articles only mentioned another concept, whereas others used the concept as part of their argument. The concept of behavioral cusps was the only one explicitly compared with all other concepts. Thus, this section addresses the direct relationships between behavioral cusp and the other concepts, and the indirect relationships between other concepts based on their approximations with the concept of behavioral cusps.

Behavioral Cusps and Behavioral Traps

Three articles identified in the search concerning behavioral cusps discussed it relative to the concept of behavioral traps: Ingvarsson et al. (2007), Robertson (2015), and Brogan et al. (2021).

The first article mentions that acquisition of the target behavior—generalized and adequate response to questions to which one does not know the answers—may facilitate the entry of children (subjects of the study) into “natural communities of reinforcement,” whereas deficits in social abilities can restrict their contact with “naturally occurring reinforcers.” The acquisition of the entry repertoire led the authors to consider it a cusp because it competed with other inappropriate responses. However,

they highlight the need to investigate how much the generalized response could lead to socially desirable interactions for those children.

Robertson (2015) discussed the concept of behavioral traps in her “cusp approach” to disruptive behaviors (discussed in the analysis of the concept of behavioral cusps above). The author argues that “[s]ome classrooms and homes may represent behavioral traps that increase the likelihood of the emergence and escalation of problem behavior.” (p. 486). In general, a relatively trivial disruptive behavior can develop in more frequent and severe forms if its occurrence favors contact with new social contingencies of reinforcement that maintain and further shape behavior.

Brogan et al. (2021) link the concepts of behavior cusp and behavior trap when discussing undesirable cusps, stating that “the combination of the relative low effort and readily available contingencies for problem behavior gives rise to a ‘behavior trap’” (p. 537). According to the authors, the learning of prosocial responses to authority figures “could be an entry point into a series of behaviors that may culminate in an alternative behavior cusp,” and the illegal behavior of adolescents in custody may be the product of behavioral traps, in which inappropriate behavior was generative.

Ingvarsson et al. (2007), Robertson (2015), and Brogan et al. (2021) emphasize that the entry response to a behavioral trap qualifies as a cusp, in agreement with Rosales-Ruiz and Baer (1997). Robertson (2015) and Brogan et al. (2021) add that behavioral traps are also relevant for the acquisition of behavior cusps in that some social environments can foster behaviors that will favor contact with new reinforcers and environments that can further expand the individual’s behavioral repertoire. Although Robertson (2015) elaborates on the interaction between behavioral traps and behavioral cusps in the context of prevention and remediation of disruptive behavior, we can safely assume that the role of behavioral traps in promoting behavioral cusps would also apply to socially valued cusps.

Based on the analyzed literature, behavioral cusps and behavioral traps may be considered complementary concepts in that behavioral traps are social environments capable of transforming the behavioral repertoire of the individuals who can enter them. Behavioral cusps are relevant both as the entry response in behavioral traps and as part of the new repertoire that may be acquired upon entrapment.

Behavioral Cusps and Pivotal Behaviors

Six articles showed approximations between these concepts: Stokes et al. (2004), Bosch and Hixson (2004), Smith et al. (2006), Bauer and Jones (2014), Robertson (2015), and Greer (2020). The relevance and necessity to investigate behavioral cusps and pivotal behaviors are highlighted (Bosch & Hixson, 2004; Smith et al., 2006), as well as the impact of the acquisition of some repertoires on the individual’s development (Bosch & Hixson, 2004), social relationships, and autonomy (Smith et al., 2006). Greer (2020) addresses the differences between the two concepts to show that behavioral cusp and pivotal behavior cannot be taken as equivalent.

In the analyzed literature, the concept of behavioral cusp appears associated with pivotal behavior and the related intervention package called pivotal response training

(PTR). Stokes et al. (2004) establish a relationship between cusp-based intervention and PRT in that both focus on behaviors that may affect significant areas of development. Likewise, Robertson (2015) considers that the concept of behavioral cusp is “represented” in pivotal response treatment due to the collateral effects observed after acquiring new behavior. The author approximates the concepts when examining the generativeness criterion for cusps proposed by Bosch and Fuqua (2001). When evaluating a potential cusp, the professionals should ask themselves whether the target behavior favors or is related to the learning of subsequent, more complex repertoires or, as asked by the author: “In other words, does the behavior change produce collateral changes in behavior?” (p. 480). Robertson (2015) explicitly relates the behavioral cusp concept to the target behaviors in PRT, as the intervention targets skills assessed as essential for the development and that may affect other behaviors, producing collateral changes in the repertoire. Hence it is reasonable to consider that at least part of the behaviors targeted in PTR-based interventions will qualify as behavioral cusps.

Greer (2020) discusses the apparent equivalence between behavioral cusp and pivotal behavior, arguing that the concepts should not be taken as synonyms. For the author, “although some cusps are pivotal behaviors, many pivotal behaviors are not behavioral cusps of development” (p. 550). An example of this would be learning to cross the street safely, considered a pivotal behavior that can lead to contact with “existing reinforcers that were not contacted before learning to cross the street.” However, the author continues, learning to cross the street would not be a cusp because it does not result in “a change in what one can learn, rate of learning, or how one can learn such as the onset of incidental learning of language or learning from observation” (p. 550).

Taken together, Stokes et al.’s (2004), Robertson’s (2015), and Greer’s (2020) approximations seem to suggest that behavioral cusps are a subset of pivotal behaviors. In line with this perspective, Smith et al. (2006) seem to propose that the behaviors that are considered cusps “can be considered a select class of target behaviors or pivotal response interventions that produce *transformational* behavioral changes” (p. 224). The authors also describe the behavioral cusp as “an entry point for pivotal behavioral change,” described as changes that “once initiated, so profoundly alters, displaces, or transforms one’s behavioral repertoire that it renders preexisting behavioral repertoires obsolete.” Because the repercussions qualified as *pivotal* coincide with the *transformational* changes they previously attributed to behavioral cusps, Smith et al. (2006) seem to define cusps as behaviors that result in pivotal behavioral changes.

It is important to note that the adjective *pivotal* appears in concepts of different logical categories, as it qualifies: (1) specific behaviors having certain repercussions (pivotal behavior); (2) collateral repercussions of the acquisition of certain behaviors (pivotal behavioral changes); and (3) types of behavioral intervention (pivotal response intervention, in general, pivotal response training, in particular). Such diverse usage leaves room for conceptual confusion in the association with the concept of behavioral cusp, which is used mainly for specific behaviors with certain repercussions. The terms *pivotal behavior* and *behavioral cusp* seem to overlap conceptually because both are labels for behaviors whose acquisition favors far-reaching

behavioral changes. Concerning its repercussions, Smith et al.'s (2006) usage suggests that behaviors classified as *cusps* would also qualify as *pivotal* because the authors consider “pivotal changes” the kind of behavioral repercussions that define behavior as a cusp.

In the context of intervention, both *behavioral cusp* and *pivotal behavior* seem to refer specifically to behavior directly targeted for intervention. Whereas “pivotal behavioral changes” apparently refer to the indirect effects of acquiring certain skills, the term *pivotal behavior* seems to apply only to the specific behaviors targeted for their expected transformational effect. In other words, because pivotal behavioral interventions are defined as indirectly affecting multiple behaviors, not all behavior benefited by such interventions will be defined as pivotal, only the explicitly trained behaviors. In stating that “cusps can be considered a select class of target behaviors or pivotal response interventions,” Smith et al. (2006) seem to imply that only a subset of the behaviors considered pivotal would qualify as behavioral cusps.

In apparent contraposition, Bosch and Hixson (2004) propose that the concept of behavioral cusp is more inclusive than that of pivotal behaviors, because it encompasses behaviors that open learning opportunities and generate desirable effects, as well as behaviors that restrict learning and have disruptive repercussions. The selected articles repeatedly identify as pivotal behaviors those that result in positive (additive) and desired repercussions on behavioral development, without openly addressing behaviors that may have negative (subtractive) and undesired repercussions.

Although Bosch and Hixson (2004) and Smith et al. (2006) appear to diverge in the hierarchy of the concepts, the two propositions of inclusivity are based on different criteria. Whereas Smith et al. (2006) indirectly associate behavioral cusps and pivotal behavior by identifying cusps as targets for pivotal interventions, Bosch and Hixson (2004) are concerned with the diversity of specific behaviors and behavioral repercussions that explicitly fall under each concept. In that regard, some texts focused on pivotal behavior discuss disruptive behaviors as collateral effects of the acquisition of certain pivotal behaviors, but in particular when the acquisition of behavior can lead, among other repercussions, to the reduction of disruptive behaviors because they are incompatible with the new repertoire (e.g., Koegel & Frea, 1993; Tseng, 2015). There seems to be no equivalent in the literature on pivotal behavior of Robertson's (2015) discussion of collateral repercussions of the acquisition of disruptive behaviors as cusps. However, considering that the articles on cusps also address mainly positive repercussions, with rare incursions into the issue of disruptive behavior and negative behavioral repercussions (as in Robertson, 2015), the silence about negative repercussions in the pivotal literature can be taken as a circumstantial omission, rather than as a necessary limitation of the scope of the concept.

There seems to be a similar imbalance concerning individual differences in behavioral cusps and pivotal behavior. In the selected literature on behavioral cusps, Rosales-Ruiz and Baer (1997), Bosch and Hixson (2004), and Smith et al. (2006) address behaviors that are considered cusps for most people and cusps that are idiosyncratic. In the selected articles on pivotal behavior, a similar issue is addressed only in Mundy and Crowson (1997), who argue that individual differences observed in early interventions

could explain why some behaviors are pivotal to some children but not others. Despite these differences in scope, the frequent conflation between cusps and target behaviors of pivotal behavioral interventions—especially in Robertson’s (2015) proposal of a cusp approach in intervening on disruptive behaviors—seems to justify assuming that the concept of pivotal behavior could also include disruptive behaviors and adverse collateral effects.

Pivotal behaviors and behavioral cusps seem to be concepts of the same logical category because both refer to specific behaviors that have critical developmental repercussions. Despite their overlapping definitions, the concepts show important differences in scope, operational criteria, and contexts of investigation and application. The concepts seem to differ also in the specificity of their transformational impact on subsequent learning because the literature strongly implies that the defining effects of behavioral cusps are a special case of the broader collateral behavioral changes that characterize pivotal behaviors. Despite this difference, the current usage seems to justify treating behavioral cusps and pivotal behavior as overlapping but not redundant concepts, at least when considering their general repercussions on development.

Behavioral Cusps, Pivotal Behaviors, Basic Behavioral Repertoires, and Cumulative-Hierarchical Learning

Three articles addressed behavioral cusps and/or pivotal behaviors relative to the concepts of cumulative-hierarchical learning and its subordinate concept, basic behavioral repertoires: Bosch and Hixson (2004), Hixson (2004), and Smith et al. (2006). Due to the aforementioned conceptual overlap between behavioral cusps and pivotal behaviors, we will discuss together their relationships with the concepts of CHL and BBR.

Bosch and Hixson (2004) bring together cumulative-hierarchical learning, basic behavioral repertoires, *generative instruction*,⁷ pivotal behaviors, and behavioral cusps as concepts related to cumulative learning effects, but that differ significantly regarding their scope. By the same reasoning described when we discussed the relationship between behavioral cusps and pivotal behaviors, Bosch and Hixson (2004) considered the concepts of pivotal behaviors and generative instruction less inclusive when compared to the others because the former refers to “specific domains of behavior” (p. 246), self-initiation and motivation, and the latter to academic abilities. Along with behavioral cusps, CHL and BBR are considered more inclusive concepts because they encompass a more diverse domain of application and include behavioral modifications that lead to negative repercussions.

⁷ This concept refers to the teaching of academic repertoires, characterized by the possibility of recombination for the emergence of more complex academic abilities (Johnson & Lyang, 1992, as cited in Bosch & Hixson, 2004). Bosch and Hixson (2004) present the concept, highlighting its proximity to behavioral cusps and CHL. It can be said that the term *generative instruction* would be equivalent to intervention on behavioral cusps concerning academic repertoires, in particular.

Hixson (2004) approximates BBR and behavioral cusps when arguing that the proponents of both concepts offer them as causal variables⁸ that are supplementary to the contingencies, influencing the current behavior. Hixson (2004) seems to treat BBR and behavioral cusp as equivalent, presenting both as concepts that describe “behavior or behavioral changes that permit access to . . . new contingencies” (p. 390).

It is possible to approximate the “developmental trajectory of critical cusps” derived from VBDT research with the concept of cumulative-hierarchical learning, although it is not an association openly declared by Greer (2020). In particular, the four experimentally identified categories of verbal developmental cusps provide a guide for intervention on verbal behavior within a cumulative, hierarchical sequence. This association is congruent with Smith et al. (2006), who position behavioral cusps as part of the targets of CHL-inspired interventions.

As already noted, Smith et al. (2006) integrated behavioral cusps into the CHL framework, defining behavioral cusps as “a special class of pivotal response interventions that help to explain [cumulative-hierarchical learning]” (p. 224). The concept of cumulative-hierarchical learning provides a molar context for identifying behaviors likely to result in “pivotal behavioral changes.” The authors adopt a syncretic terminology, which allows for multiple associations between the concepts under analysis. Although they do not mention BBR explicitly, in the CHL framework, BBR corresponds to behaviors that affect subsequent behavioral outcomes. If BBR is to be understood as the target of CHL-oriented interventions, then behavioral cusps could also be taken as a special class of BBR. In addition, Smith et al.’s use of *pivotal* to qualify both intervention strategies and the overarching repercussions of cusp acquisition encourages the interpretation that behaviors targeted by the interventions are also considered pivotal. This usage encourages a conflation among the concepts of BBR, pivotal behavior, and behavioral cusp in a broad category of behaviors that can have important effects on subsequent learning. In general, all concepts refer to behaviors that, when acquired, affect the possibility and quality of more complex repertoires.

An obstacle to treating the three concepts as belonging to the same logical category is the controversial use of BBR as a higher-level concept (e.g., a constellation of behaviors; a potential for action). As Holth (2003) has shown, such usage slips into category mistake if BBR is defined as a superordinate behavioral category and then causally related to behavior implied in the superordinate category (as seems to be the case in the usage by Staats, 1996, examined by Holth). As we have discussed, such conceptually confusing usage can be avoided by emphasizing that at least part of what is identified as BBR consists of collections of related behaviors and shifting the focus of analysis to the discrete behaviors required for competency validation. This seems to be the case with the concept of behavioral cusp, which also refers to

⁸ Although the concept of BBR appears as part of causal explanations similar to those formulated from inferred processes, in cognitive theories (as also criticized by Holth, 2003), it is not clear where this occurs in the literature on behavioral cusps. At least, it does not appear to be an explicit proposition by Rosales-Ruiz and Baer (1997).

both individual behaviors and collections of behaviors without generating conceptual confusion.

This analysis places BBR, behavioral cusp, and pivotal behavior in the same logical category, but there seems to be no good justification for treating the three as redundantly equivalent. From the general conceptual overlap in addressing behavior whose acquisition affects subsequent behavioral development, it appears the three concepts can be related inclusively, in a superset–subset fashion, based on the specificity of their effects. This inclusive relationship appears to be uncontroversial in the case of pivotal behavior and behavioral cusps (e.g., Rosales-Ruiz & Baer, 1997; Smith et al., 2006). For example, commenting on Koegel and Frea's (1993) report that teaching students eye contact and appropriate facial expressions may lead to widespread and important effects on communication, Rosales-Ruiz and Baer (1997) say:

To the extent that these collateral behavior changes prove to be important or introduce the organism to new shaping environments that prove to be important, they are cusps as well as pivotal behaviors. If, for example, the collateral behavior changes seem to be only brief, stereotypic conversations about very few topics, they remain collateral behavior changes, but their importance to the child or to others seems problematic, and thus they may not be cusps. (p. 537)

If behavioral cusps can also be taken as a select class of BBR (from Smith et al.'s usage), it means that some BBR may open opportunities for behavioral transformations, such as those that define cusps, but the literature suggests that not all behaviors considered BBR qualify as cusps. Not all BBR will have effects considered pivotal/transformational in Smith et al.'s (2006) sense because the concept sometimes seems to refer simply to direct prerequisites for subsequent learning, without the generative, comprehensive, and far-reaching connotation of the other two concepts of the same category. Rosales-Ruiz and Baer (1997) differentiate behavioral cusps and prerequisites in terms of the reach of their effects: a cusp exposes the organism to possibilities of interaction that were previously unavailable, whereas a prerequisite “opens the child's world only to the next skill” (p. 535). This separation does not necessarily mean that they are mutually exclusive concepts, because being a direct prerequisite for subsequent learning does not eliminate the possibility of the behavior serving as a cusp. For example, crawling would be a behavior cusp, resulting in access to unprecedented contingencies, while also being a prerequisite for walking.

One way of resolving this issue would be to examine whether any behavior deemed as BBR or pivotal would also qualify as a cusp in light of the criteria proposed by Bosch and Fuqua (2001). However, because it is not necessary to meet all criteria for a behavior to be considered a cusp (e.g., Robertson, 2015), such an examination may inadvertently reduce all concepts to the concept of behavioral cusp instead of informing a fine-grained separation among BBR, pivotal behavior, and behavioral cusps. As Robertson (2015) pointed out, “the greater number of criteria met and the more profoundly criteria are met may differentiate more important cusps from less important cusps” (p. 477).

Although Bosch and Hixson (2004) consider behavioral cusps, BBR, and CHL more “inclusive” than pivotal behaviors, this is based on the variety of behavioral

problems and contexts typically addressed in research and interventions informed by different conceptual frameworks. When we consider the relationships between the concepts in terms of their general operational definition (behaviors whose acquisition has important effects on subsequent behavioral development) and their participation in intervention strategies (behaviors that are targets of intervention for their potential behavioral repercussions), it is defensible to conflate behavioral cusp, pivotal behavior, and BBR as concepts of the same logical category.

Following Smith et al. (2006), the notion of cumulative-hierarchical learning can be taken as an organizing description of behavioral development throughout life, providing context for the concepts of pivotal behavior, behavioral cusp, and BBR as behaviors that may influence the acquisition of other behaviors relevant to development. Thus, CHL is a concept of a superordinate category presupposing the other concepts. In practical terms, whereas the molar concept CHL informs the design of interventions based on the current repertoire, and aims to produce increasing behavioral complexity over time, the molecular concepts of BBR, pivotal behavior, and behavioral cusp guide the selection of prerequisite behaviors considering the individual's current repertoire (Holth, 2003). Within the CHL framework, BBR, pivotal behavior, and behavioral cusps may all be said to be prerequisites for developmental outcomes, but are defined by different effects on subsequent behavioral development.

Proposed Conceptual Integration and Organizing Narrative

The concepts reviewed here were proposed and developed in conjunction with basic and applied research on behavior modification. However, they could be extended to the interpretation of typical development because the behavioral regularities observed under planned conditions presumably also occur spontaneously. It seems relevant to explore whether the concepts can be integrated into a conceptually coherent narrative about how environmental contingencies can guide behavioral development through relatively predictable and generalized “milestones.”

Our comparative analysis showed that BBR, behavioral cusps, and pivotal behaviors—although originated and established in different conceptual and methodological ecologies—are overlapping concepts because all three involve behavior whose acquisition affects subsequent learning in developmentally important ways. The three conceptual frameworks aim to clarify the transformation of simpler behaviors into complex repertoires that can affect the individual's social relationships, quality of life, and autonomy. Based on this convergence, we propose to merge these concepts without losing sight of their defining differences.

In part, this simply accepts as canonical tacit confluences already present in the literature but without treating the concepts as synonyms. In this sense, we propose a conceptual systematization of the relationship between the three classes of behaviors based on the specificity of their effects. As mentioned earlier, the three concepts can be merged in a superset–subset fashion. We regard BBR as the superset because it appears to be the most diverse class—apparently including direct prerequisites for more complex behavior, behaviors that have pivotal effects, and behaviors whose pivotal effects include cusp-defining effects. The

intermediate subset would include those basic behavioral repertoires characterized by far-reaching collateral effects in multiple behaviors and subsequent learning (pivotal behaviors). Behavioral cusps would be a subset of pivotal behaviors whose pivotal effects include access to novel contingencies.

Our analysis showed that CHL is a polysemic term with meanings that range from a descriptive model of the emergence of increasingly complex behavior to a “family of normative behavioral practices and procedures” (Smith et al., 2006, p. 224). Here, we will use the term “cumulative-hierarchical learning” to refer to an extended process of higher-level behavioral repertoires gradually and progressively emerging from basic behavioral repertoires. Our formulation maintains the subordination of the BBR concept to that of CHL. The conflation among BBR, pivotal behaviors, and behavioral cusps implies that cumulative-hierarchical learning depends on the occurrence of basic behavioral repertoires with varying degrees of repercussions on subsequent learning, which will be further classified as pivotal or cusps depending on the specificity of these repercussions.

This conceptual organization seems to be congruent with Smith et al.’s (2006) treatment of behavior cusps as a special class of pivotal response interventions targets “that help to explain CHL” because pivotal interventions are said to affect a broad class of behaviors that promote contact with *individual* and *reciprocal* contingencies of varying complexity. Our formulation conflates BBR, pivotal behavior, and behavioral cusps in the broad class of targets for pivotal behavior interventions. Thus, among the basic behavioral repertoires targeted for intervention, some will only serve as a direct prerequisite for learning more complex behaviors; other BBR will also have larger collateral effects considered pivotal, whereas a portion of pivotal BBR will also serve as cusps.

In their effort to integrate behavioral cusps within the CHL framework, Smith et al. (2006) argued that some behaviors and repertoires might “be pivotal to promoting individual and mutually reinforcing (reciprocal) higher-level networks, patterns, and structures within and across family, community, and other environments” (p. 223). In other words, environments of varied social complexity become accessible through behavioral cusps. In addition to the notion of BBR as a superset containing pivotal behavior and behavior cusp, we propose that it may be useful to explicitly incorporate behavioral traps in the CHL framework to emphasize the environmental component of the cumulative-hierarchical process. In particular, we recommend combining the metaphor of a stream of cumulative and hierarchical behavioral changes with a parallel “environmental stream,” representing a succession of increasingly complex behavioral traps. A background hypothesis in this conceptual integration is that access to increasingly complex environments occurs cumulatively and hierarchically as the individual gradually acquires important behavioral cusps.

In this sense, it is relevant to stress the interdependence between the concepts of behavioral cusps and behavioral traps because moving along the succession of incrementally complex behavioral traps will be contingent on acquiring certain entry responses. Integrating the cusp/trap combo within the CHL framework may help introduce new questions and hypotheses into the reasoning about what may be

happening—or should be happening—in the development environment in parallel with developmentally critical behavioral changes.

Baer and Wolf (1967) suggested examining the entrapment hypothesis for natural communities of reinforcement other than the preschool, such as the verbal community and the university. If taken as an organizing narrative of behavioral development, a cusp/trap-centered conceptual integration could contribute to examining the role of a variety of spontaneously occurring (as opposed to experimentally controlled) social contingencies in promoting the occurrence and maintenance of behavioral changes that typically emerge in the population. In other words, the concept seems useful to guide the search for the environmental conditions that foster the behavioral modifications recognized as “developmental milestones.”

Entering a behavioral trap is conducive to behavioral diversification that eventually will include new behavioral cusps (e.g., Robertson, 2015), meaning skills that open access to new behavioral traps. It is reasonable to infer that some culture-typical contingencies will trap behavioral development and favor the spontaneous shaping of multiple responses, some of which will be pivotal to expose the organism to slightly more complex culture-typical contingencies, previously inaccessible, resulting in repeated cycles of behavioral entrapment. From the perspective of the environmental conditions for behavioral development, the incremental access to new behavioral traps may be the basis for both the cumulative-hierarchical character of behavioral development and its relative populational regularity, assuming that the cusp-dependent traversal of culture-typical behavioral traps will result in culture-typical cumulative-hierarchical learning. In this sense, the developmental process can be summarized as a kind of “macro shaping,” with the entry into new behavioral traps shaping the global behavioral repertoire by successive differentiations.

Final Considerations

This review aimed to systematize the relationships among some behavior-analytic concepts concerning developmentally critical behavioral changes. We examined the usage of each concept in selected peer-reviewed publications, focusing on arguments about their scope, role in development, conceptual limitations, practical applications, and theoretical approximations. The resulting conceptual integration and organizing narrative should not be confused with a behavior-analytic “theory of development,” proposing a final working explanation, but as a provisional hypothesis. We believe that our study provides a comprehensive overview of behavior-analytic propositions about developmental changes, resuming the thesis of precursors in the field and promoting an organization of concepts that different researchers have proposed.

First, it is worth remembering that Skinner rejected conceptions of development based on unpacking information from genes and on the notions of fixed stages, phases, and milestones. Opposing these conceptions, Skinner drew attention to the role of the environment in defining the course and direction of development, especially stressing the idiosyncratic character of organism-environment relationships. Later, Bijou and

Baer defined development as progressive changes in how the organism interacts with the environment. The conceptual integration of developmental behavior-analytic concepts in this study not only endorses but expands on the initial propositions of Skinner, Bijou, and Baer on the environmental conditions responsible for regularities in development. This expansion can be seen in the coherent combination of concepts from different traditions of behavior-analytic research and intervention on human development in a heuristic model that emphasizes the participation of the environment in the increasing behavioral complexification expected in typical development.

Second, considering the robust and diversified behavior-analytic studies on development, we expect our formulation to contribute to the integrative efforts already initiated in the literature by emphasizing the converging and complementary aspects of the different conceptual frameworks and solving some conceptual confusions. We believe that our formulation organizes the conceptual field in a way that respects the conventional use of concepts, preserving their strengths. Although there are differences in the conceptual frameworks, none seemed to preclude coherent integration. The integration of BBR, pivotal behavior, and behavioral cusps under CHL does not have the merely aesthetic effect of positioning the concepts within a stream of increasingly transformative learning. In integrating cusp and CHL, Smith et al. (2006) invite researchers and practitioners to consider Bosch and Fuqua's (2001) criteria—which Smith et al. have characterized as the “pivotal behavioral elements”—in planning behavioral changes relevant to research and intervention. With the conceptual integration and organizing narrative proposed here, we hope to have advanced a little further along the path already paved by Smith et al. (2006).

Following Smith et al. (2006), we sought to reconcile the concepts and integrate them into a cumulative-hierarchical learning framework, highlighting the environmental conditions that promote developmentally relevant behavioral transformations represented by the concept of behavioral traps. Although environmental contingencies are always implied in concepts related to target behaviors—especially in the case of behavioral cusp, which presupposes a “shaping community of reinforcement” (Rosales-Ruiz & Baer, 1997, p. 542)—we advocate that the environmental component be stated more explicitly in any conceptual integration. We believe this proposition resonates with Baer and Wolf's (1967) request that the design of behavioral interventions considers prerequisites for entry into natural communities of reinforcement that promote desirable behavioral transformations. The proposal also meets Fogaça et al.'s (2019) request for more significant investment in descriptions of “which contingencies select the behavioral cusps, as well as the estimation of which contingencies the cusp allows access to” (p. 226). In addition, explicitly incorporating behavioral traps within the CHL framework can provide a helpful heuristic model to guide research on how culture-typical contingencies relate to chronological coincidences among individuals in the acquisition of developmentally critical behavior, an issue posed by Skinner (1974) and Rosales-Ruiz and Baer (1997). Aided by insights from decades of experimental and applied research on atypical behavioral development, nonexperimental

and semi-experimental research in natural settings could help elucidate whether naturally occurring cumulative-hierarchical learning reflects the cusp-dependent access to increasingly complex environments. The eventual identification of a succession of behavioral traps critical to typical development can provide inputs for individual-centered interventions focused on ensuring the requisite repertoires for contacting the relevant contingencies of reinforcement.

Third, regardless of the formulation proposed here, we believe that integrating the various development-related concepts within a cumulative-hierarchical learning framework can serve as shared conceptual terrain, leading to the mutual refinement of the various conceptual and methodological frameworks. The conceptual integration can bridge lines of research and application that have been developing parallel conceptual and methodological frameworks, despite acting on similar behavioral phenomena. For example, consider *bidirectional naming* (BiN), which has been explored experimentally as a behavioral cusp in verbal behavioral development theory (VBDT; e.g., Greer, 2020). BiN would likely be considered a BBR in investigations informed by the CHL framework. Given the confusing definition of BBR, this conceptual redundancy could be a further argument for abandoning the BBR concept and, perhaps, the very notion of CHL (cf. Hixson's, 2004). As an alternative, a conceptual integration that favored a more proactive exchange between the two fields could contribute to refining the conceptual basis of CHL-based interventions. VBDT findings on the “speaker-as-own listener operants” that demonstrate BiN and on the progression of critical verbal behavioral cusps in a developmental trajectory may serve to (1) inform a more operational definition of the components of a BBR; (2) provide a template of how the components interact to yield “coherent behavioral repertoires and emergent or generative behavior” (Lund, 2001); and (3) provide empirical evidence of the learning hierarchy assumed in the CHL framework. On the other hand, viewing BBR and behavioral cusp in superset–subset relation, rather than redundant or mutually exclusive concepts, may clarify whether all instances of BiN in fact qualify as behavioral cusps regarding the transformative repercussions on subsequent learning. Finally, bringing together insights from research and intervention could inform the search for key behavioral and environmental variables in investigating how society arranges contingencies that promote orderly and predictable changes for typical verbal development.

This review had limitations that may have biased our conclusions and propositions, such as the exclusive use of articles in the analysis, the exclusion of texts that only mentioned the terms without further elaboration, and basing the analysis of conceptual interrelationships exclusively on articles that associated at least two concepts. Further research could confront the present findings and interpretations by expanding the list of search terms to include the variations identified in this review for each concept (see Tables 3, 4, 5 and 6 in the Appendix), covering books and other bibliographic sources, and subjecting the articles selected in this review to different categories of analysis.

Appendix

Table 2 Number of occurrences per keyword for each step of the procedure and (*) total selected articles after removing repetitions in each category and between categories

Concept	Keywords	Search results	Down-loaded articles	Selected by type, date, and language	Selected by terms in specific sections	Selected for contextualizing the terms	Included articles
Behavioral Traps	“Behavioral traps”	41	33	1	1	1	2
	“Behavioural traps”	16	10	0	0	0	
	“Behavioral trapping”	8	7	5	1	1	
	“Armadilhas comportamentais”	0	0	0	0	0	
Cumulative-Hierarchical learning	“Cumulative-hierarchical learning”	18	17	13	5	5	6
	“Basic behavioral repertoires”	46	21	12	1	1	
	“Aprendizagem hierárquica”	0	0	0	0	0	
Pivotal Behaviors	“aprendizagem hierárquica cumulativa”	0	0	0	0	0	
	“Pivotal behavior”	95	75	10	8	5	13
	“Pivotal skill”	192	162	37	13	5	
	“Pivotal social skills”	37	35	15	2	2	
	“Comportamentos pivotaes”	0	0	0	0	0	
	“Comportamentos-chave”	3	3	0	0	0	

Table 2 (continued)

Concept	Keywords	Search results	Down-loaded articles	Selected by type, date, and language	Selected by terms in specific sections	Selected for contextualizing the terms	Included articles
Behavioral Cusps	"Behavioral cusp"	61	52	8	8	7	18
	"Behavioral cusps"	76	75	35	8	7	
	"Developmental cusp"	31	23	5	4	4	
	"Verbal developmental cusp"	14	12	3	3	2	
	"Behavioral developmental cusp"	7	4	3	3	1	
	"cúspide comportamental"	0	0	0	0	0	
	"cúspide desenvolvimento"	0	0	0	0	0	
	"cunha comportamental"	1	1	1	0	0	
	"salto comportamental"	0	0	0	0	0	
	"ápice comportamental"	1	1	1	1	1	
	"cusp comportamental"	0	0	0	0	0	
	"cusp desenvolvimento"	0	0	0	0	0	
Total		646	531	148	58	42	31*

The asterisk beside the number 31 indicates the total of articles after removing repetitions between categories

Table 3 Variations for the search term “Behavioral traps” identified in the selected texts

Variations	Trapped	Natural contingencies of peer reinforcement	Peer social contingencies
Behavioral trap	Natural contingency of reinforcement	Natural communities of reinforcement	Entrapment
Behavior traps	Natural contingencies of reinforcement	Natural communities of social reinforcement	Entrapment hypothesis
Trap	Natural reinforcement contingencies	Natural communities of social reinforcement contingencies	Entrapment effect
Traps	Natural reinforcement contingency	Peer reinforcement contingency	Peer entrapment hypothesis

Table 4 Variations for the search terms “Basic behavioral repertoires” and “Cumulative-hierarchical learning” identified in the selected texts

Variations			
Cumulative-hierarchical learning	Cumulative-hierarchical learning process	Cumulative reciprocal learning	Basic behavioral repertoires
Cumulative nature of learning	CHL	Basic behavioral repertoire (BBR)	General BBR
Cumulative-hierarchical behavior sequence	CHL behaviors and repertoires	BBR	Anti-learning BBR

Table 5 Variations for the search terms “Pivotal behavior,” Pivotal skill,” and “Pivotal social skill” identified in the selected texts

Variations			
Pivotal	Pivotal skills	Pivotal skill hypothesis	Key pivotal developmental behaviors
"pivotal"	Pivotal social behaviors	Pivotal skill development	Pivotal response class
Pivotal behavior	Pivotal skill arena	Pivotal skill instruction	Pivotal individual difference markers
"Pivotal behavior"	Pivotal skill domain	Key pivotal behaviors	Children’s pivotal behavior
Pivotal behaviors	Pivotal behavior change	Pivotal developmental behaviors	Children’s pivotal developmental behavior
"Pivotal" behaviors	Pivotal behavior use	Pivotal behavior initiation	Children’s global pivotal behavior
Pivotal role	Pivotal behavior effect	Pivotal intervention objectives	Pivotal behavior model

Table 6 Variations for the search terms “Behavioral cusp,” “Behavioral cusps,” “Behavioral developmental cusp,” and “Developmental cusp” identified in the selected texts

Variations			
Cusp	Behavioral cusp process	Verbal cusps	Behavioral developmental cusp
Cusps	Behavioral cusp actions	Naming cusp	Behavioral developmental cusps
Cusp response	Behavioral cusp framework	Listener literacy cusp	Foundational cusps
Cusp concept	Behavioral cusp approach	Listener cusp	Key developmental cusps
Behavioral cusp	Cusp approach	Observational cusp	Verbal foundational cusps
Behavioral cusp concept	Potential cusps	NE (naming by exclusion) cusp	Verbal behavior developmental cusp
Behavioral cusp model	Cusp potential	Basic listener cusp	Verbal behavior developmental cusps
Behavioral cusps	Potentially important target behaviors	Developmental cusp	Behavioral developmental learning cusp
Key behavioral cusps	Potential negative cusps	Developmental cusps	Desirable cusp/undesirable cusp

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Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

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