European Journal of Behavior Analysis

ISSN: 1502-1149 (Print) 2377-729X (Online) Journal homepage: http://www.tandfonline.com/loi/rejo20

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To cite this article: Martha Pelaez & Gary Novak (2013) "Hidden" Skills and Deficits in the Emergence of Autism, European Journal of Behavior Analysis, 14:1, 87-96

To link to this article: http://dx.doi.org/10.1080/15021149.2013.11434447

Published online: 10 Jun 2015.

"Hidden" Skills and Deficits in the Emergence of Autism

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Autism encompasses a set of pluralistic developmental behavioral interactions that are organized into patterns that are both characteristic of the autism diagnosis and unique to the individual. We discuss three aspects underlying the development of autism: nonlinearity, cusps, and the notion of "hidden" skills and deficits**.** Autistic characteristics may suddenly emerge from skills previously undetected. Because these skills are necessary but not sufficient for the development of other behaviors, they can be identified as behavioral cusps. Because these skills are "hidden" (not readily observed), identifying and assessing them is a challenge to researchers and clinicians. In this paper we discuss some typical hidden skills and deficits that may contribute to the development of autistic behavior and provide examples of how they function developmentally in autism. Early detections of these skills and deficits are crucial for establishing the behavioral developmental cusps for typical development and avoiding the cusps for the development of autism.

Key words: autism, skills, deficits, behavior analysis, overselectivity

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In behavior analysis there is limited theoretical understanding of the multiple contextual determinants of child development and the systems involved. This lack of perspective might limit the ability of behavior analysis to impact complex phenomena. For example, in areas like autism, even though we have contributed to the advancement of interventions more than any other discipline or psychological approach, behavior analysis might be reaching a ceiling effect in treating this disorder. This is because as basic and applied researchers, our main problem is that we have seldom dealt with the complexities of human development and have not developed the tools required to analyze the multiple concurrent variables affecting moment-to moment child-environment interactions. Our single-subject design tradition has for the most part created interventions that manipulate one variable at a time while keeping the others constant. Autism encompasses a set of pluralistic developmental behavioral interactions that are organized into patterns that are both characteristic of the autism diagnosis and unique to the individual. The course of developing autism is influenced

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This article is based on a paper presented at Murray Sidman's Festschrift in Sarasota, Florida, October 8, 2012. Portions of this presentation were reported in Novak, G., & Pelaez, M. (2011), *Autism: A behavioral-systems approach*, in J. A. Mulick and E. A. Mayville (Eds.), Behavioral Foundations of Effective Autism Treatment. Cornwall-on-Hudson, NY: Sloan Publishing.

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by multiple factors and systems, including the biological, organismic, and historical variables that are difficult to observe and that are in constant reciprocal interaction with the environment.

Elsewhere (Novak, 1996; Novak & Pelaez, 2004; Novak & Pelaez, 2011), we have outlined an approach to development that combines behavior analysis with the dynamic systems approach to development presented by Esther Thelen and others (Fogel, 2011; Thelen, 1995; Thelen & Smith, 1994). Our behavioral systems approach is characterized by several features, including, a) maintaining a natural science perspective, b) treating ontogenic development as a process that parallels phylogenic development, c) emphasizing naturally occurring contingencies as the primary shaper of development, d) and understanding development in context. A significant part of this viewpoint is that behavior changes over time as the result of continuous on-going reciprocal interactions between multiple determinants of child development that include: 1) the genetic-constitutional make-up of the individual and the biological equipment that results; 2) the learning or interactional history of the person with the environment; 3) current physiological conditions; 4) current environmental (in the sense of stimulus) conditions; and 5) the influence of earlier behavioral trajectories on current development, or behavioral dynamics, including behavioral momentum. In this paper, we limit our discussion to three relevant aspects underlying the development of autism: nonlinearity, phase shifts or cusps, and the notion of "hidden" skills and "hidden" deficits, and provide a few examples of each.

Nonlinearity in the Emergence of Autism

The common medical view of behavioral disorders assumes a linear model of development. A linear model is one in which outcomes are additive functions of the inputs. That is, development of behavior increases or decreases in frequency, magnitude, or variability at a constant rate. Much of experimental behavior analysis follows this linear approach. For example, McDowell has published extensively on how nonlinear phase shifts in free operant responding can be explained using nonlinear systems models (McDowell, Bass, & Kessel, 1992; McDowell, Bass, & Kessel, 1993). Encouraged by the view of autism as a neurological disorder resulting from a biological cause (either genetic or environmentally induced), a linear approach typically assumes that the child inherits or develops autism and continues to show constant, lessening, or worsening levels of autistic behavior over time. From this linear perspective specific behavior, such as autistic aloneness, may be thought to exist initially and continues to worsen until it reaches a point at which the child is diagnosed as autistic. At that point, the manifested disorder and its concomitant behaviors may level off, get worse, or reverse course and gradually lessen. Regardless of the trajectory, the child is called autistic. In behavior analysis, however, changes in observed behavior are viewed as differences in quantity rather than differences in quality (for example, increased frequencies and magnitudes of stereotypic behavior or echolalia). Furthermore, our developmental behavioral systems approach takes the view that many important behavioral changes may be nonlinear. That is, it considers it critical to detect sudden changes not only in frequency or magnitude, but in the *organization of existing behaviors* so that new constellations of behaviors may emerge as in emergent equivalence relations and derived relations. These sudden changes or "phase shifts" can be quantitatively or qualitatively nonlinear.

Two areas of behavior analysis that focus on nonlinear changes are *stimulus equivalence* (Sidman, 1994) and *relational frame theory* (Hayes, Barnes- Holmes, & Roche, 2001). In the standard stimulus equivalence paradigm, "Once explicit reinforcement

contingencies had established the original AB and BC relations, all the other relations were emergent—not having been involved in any reinforcement contingency (Sidman, 1994)." The emergence of non-trained identity, symmetry, and transitivity relations constitute a nonlinear phase shift. While stimulus equivalence research has been concerned with stimulus-stimulus relations, relational frame theory has emphasized the transformation of stimulus functions and the emergence of relational frames as higher order units of responding emerging as a function of multiple exemplar experiences (Hayes, Fox, et al., 2001).

We think that understanding complex behavioral development necessitates a nonlinear model to account for qualitative as well as quantitative changes in behavior and stimulus-behavior relations over time. In a nonlinear model, autistic characteristics, which were previously undetected either because the environment may not evoke them or because individually they may not constitute unusual behavior, may suddenly emerge. As previously noted, these sudden qualitative or quantitative changes in levels or kinds of behavior are called "phase shifts" (Thelen & Ulrich, 1991). When these phase shifts lead to the emergence of behaviors that are significant or important for the development of many other behaviors, these phase shifts are called "behavioral cusps" (Rosales-Ruiz & Baer, 1997), or perhaps more accurately, from a behavioral systems perspective, "behavioral developmental cusps" (Greer & Longano, 2010). By definition, the identification of a new response class as a "cusp" depends on pragmatic criteria such as the extent it leads to new environmental interactions, whether it generates new response classes, whether it affects inappropriate responses, the extent it impacts people, and in the degree of social validity (Bosch & Fuqua, 2001). Thus a new behavioral cusp involves the emergence of a new behavior that is important for the development of many other behavioral paths.

Unfortunately, diagnosis of autism typically does not occur much before age 3 and contemporary research efforts are being devoted to its early detection. Early intervention has proven to be effective in treating autism. Recent work compatible with a behavioral systems viewpoint (e.g., (Greer & Keohane, 2006; Hixson, Reynolds, Bradley-Johnson, & Johnson, 2011) has focused on identifying behavioral cusps, such as joint attention, social referencing, perspective taken, and naming that might be absent in the development of autism. A significant problem remaining is that some critical behaviors are not readily observed under typical environmental conditions. Therefore, while we are slowly beginning to identify the sudden emergence of new and important behavioral phase shifts of development that will lead to either autistic or typical development, it is also important to identify the necessary, but not easily observable skills (Novak & Pelaez, 2004; Novak & Pelaez, 2011) underlying the emergence of cusps. In the following section we elaborate further and provide examples.

"Hidden" Skills and Deficits

Contributing to the difficulty in identifying early indicators of autism is that in development some individual components of a pattern of behavior may be present, but not readily observable, because often the conditions necessary for their occurrence are not present. For example, Thelen and Ulrich (Thelen & Ulrich, 1991) carefully studied bipedal walking in infants between 1 and 9 months of age. Although under typical environmental conditions children take their first steps between 9 and 17 months (Glew & Bennett, 2009), under extraordinary environmental conditions (i.e., a supportive harness and appropriate speed treadmill), mature patterns of walking were observed in children between 3 and 6 months of age. Thelen and Ulrich (1991) used the term "'hidden' skills" to describe this organized

pattern of behavior that is not seen under normal conditions. Some skills are "hidden" because the typical environment and necessary companion skills are insufficient to evoke and reinforce them. Even though several of the necessary components of the cusp of bipedal walking (such as balance and inter-limb coordination) are present in infants' repertoires months before they are able to walk, these components are not sufficient to be organized by the child-typical environment into an observable skill. Therefore, under normal conditions, these skills are "hidden" and not observed. However, under normal conditions the existing skills are unobservable because other needed skills, such as supporting the weight of the body by the legs and holding the proportionally large head upright, are missing, making it impossible for all the skills of walking to come together (or coalesce) under normal conditions. The change toward a less head-heavy body enables the "hidden" skills to coalesce with others resulting from physiological changes (e.g., growth) and interactions acquired through other forms of locomotion (including creeping and crawling). The result is that prompted by the social and physical environment, near the end of the first year the behavioral developmental cusp known as walking emerges and is automatically reinforced. Likewise, some autistic behaviors may be hidden because under normal conditions they are not evoked or reinforced by normal environments and do not appear until later when all components allow the autistic behavior to function. In a related sense, the absence of important skills may not be apparent because they are not observed under typically occurring environmental conditions. Therefore the absence of the "hidden" skills essentially makes them "hidden" deficits. The result of both "hidden" skills and "hidden" deficits is that the development of autism is mostly undetected during the period when early intervention is most effective (Granpeesheh, Dixon, Tarbox, Kaplan, & Wilke, 2009).

In sum, "hidden" skills underlying autistic or typical behavioral cusps may be present early, but are hidden because, alone, they do not produce autistic behaviors. Instead they are necessary components or precursors for the development of autistic behavior. These skills may be necessary, but at the existing level of development, are not by themselves sufficiently supported by the environment for them to appear. However, the development of other "hidden" or apparent skills, organismic (e.g., muscle mass) characteristics, and environmental conditions (e.g., history of behavior-environment interactions) over time, enable their coalescence into emergent patterns of behavior that are then identified as cusps central to autism. Likewise "hidden" deficits contribute to autism because the missing skills prevent the coalescence of skills into developmental behavioral cusps necessary for typical development, instead enabling the development of alternative (i.e., autistic) patterns of behavior such as social avoidance or echolalia. Because "hidden" skills are in the child's repertoire along with other components of the cusp, early detections of these skills (or their absence) is crucial for establishing the behavioral developmental cusps for typical development and avoiding the cusps for the development of autism. Because they are "hidden", identifying and assessing them is a challenge to researchers and clinicians who must provide special environmental conditions to make them apparent.

Behavioral Developmental Cusps

In recent years researchers have spent considerable time identifying crucial behavioral developmental cusps that are present in typical development and absent in autistic development (Hixson, 2004; Hixson et al., 2011). Three important early cusps are the reciprocal positive interactions between young children and adults called "mutually responsive orientation" (Kochanska, 1997), the gaze shifting and stimulus control known

as joint attention (Holth, 2011), and the development of social discriminative stimuli called social referencing (Pelaez, 2009). Hixson, et al., (2011) provide a list of several other behavioral cusps relevant to the treatment of autism.

An important "hidden" skill that appears to be present in the development of autism is stimulus *overselectivity*. Responding to multiple cues (i.e., the opposite of stimulus overselectivity) has been identified as a "pivotal response" (Koegel & Koegel, 2006). Stimulus overselectivity is "hidden" under typical environmental conditions for young infants who normally experience complex stimulus arrays and few contingencies for responding to more than one stimulus. Under these conditions, responding to one stimulus class to the exclusion of others goes unnoticed because of the redundancy of the stimulus environment (e.g., parents moving close to the child, repeating the child's name, and using simplified "motherese") and the absence of contingencies for incorrect stimulus control that exists in most early child-environment interactions. It is often only later, when contingencies change, that stimulus overselectivity may be identified and treatment begun.

Under what conditions does a cusp such as joint attention or naming develop? We have emphasized in our writings (e.g., (Novak, 1998; Novak & Pelaez, 2004, 2011) the importance of bi-directional influences between the characteristics of the mother and the child, and the importance of development of positive, contingent, and synchronized social interactions as a skill. Field and her colleagues (Field, 1982, 1986; Field & Osofsky, 1987; Malphurs et al., 1996) have looked at premature infants, who by virtue of their biological immaturity (at birth), seem to have a smaller range of tolerance to social stimulation than full-term infants. For premature infants, more stimulation is required to arouse them into attending to their mother, but they are also more easily over-aroused by social stimulation the mothers provide. The result is either they do not begin to interact with mother, or, when they finally do, the over-stimulation provided by the mothers' involvement too quickly produces gaze aversion by the child. This is followed by fussing and ultimately crying if the mother does not reduce the stimulation. Prior to "interaction training" at risk dyads did not develop good interactions because mothers were not active enough to get their child's interest, or, if they did get the child's attention, failed because the mother's over-stimulation made the infant cry. Using instructions and feedback, the authors were able to teach mothers to be sensitive to the infant's responses, coaching intrusive mothers to slow down their interactions and uninvolved mothers to enhance their infant's attention (Malphurus, et al., 1996). The development of positive social interactions is a dynamic interplay between infant behaviors and the mother's behaviors that may fail due to mismatches between the two. Failure is also likely to lead to avoidance of social interaction by either the child, the parent, or both.

Some "Hidden" Deficits in Autism

We emphasize in this paper and elsewhere (Novak & Pelaez, 2004, 2011) the importance of "hidden" skills and deficits in enabling the coalescence of biological and learned characteristics in the sudden emergence of behavior. The organized patterns of behaviors considered in autism have typically not coalesced into a diagnosable pattern until the age of two or three. Dynamical systems theories (e.g., (Novak & Pelaez, 2004; Thelen & Ulrich, 1991) suggest that early in the emergence of a response class, before much reinforcement of the emerging response class has occurred, behaviors are more variable and more easily disturbed or changed. For example, relatively small environmental changes (e.g., a baby confined too long to a playpen) can disrupt the development of walking of new walkers (Adolph & Avolio, 2000; Adolph, Vereijken, & Shrout, 2003).

But once behavioral classes are well reinforced, they become less variable and less easily changed. In a similar fashion, the disproportionate effect of small influences occurring early in the development of autistic and typical children, may explain why it is recommended that early behavioral intervention be begun as early as possible. It is important to intervene before the autistic pattern becomes well organized through natural reinforcement contingencies that maintain the behavior in the child's natural ecology. This "the earlier the better" approach has fueled the so far elusive search for earlier identification of autism or early precursors to autistic development.

In this search, much of the non-behavioral research has looked for physiological indicators, such as genetic or brain abnormalities. No clear physiological indicators have been identified, but some behavioral genomic studies have found limited linkages of some areas of some chromosomes to autism (Plomin & McGuffin, 2003). Another approach is to look for early behavioral indicators that seem to be precursors for the development of autism including the cusps of mutual responsive orientation, joint attention, social referencing, and perspective taking (Pelaez, 2009). In our view, there are also additional "hidden" skills or "hidden" deficits that are necessary contributors to the development of cusps, but which, by virtue of their hidden nature are not apparent under typical behavior environment interactions. Part of a necessary research agenda will be to identify these "hidden" skills developing procedures to assess and treat them as early as possible since they may be seen as necessary, but not sufficient components in the development of autistic behavior.

Such a possible research approach is illustrated by the work of Pelaez, Virués–Ortega & Gewirtz (2012). Pelaez and colleagues identified the reinforcing and discriminative effects of maternal facial expressions and the conditioned reinforcing functions that these stimuli provide in the acquisition of infant social referencing. In typically developing infants, social referencing was treated as a form of discriminative learning in which maternal facial expressions signaled the consequences of the infant's behavior in an ambiguous context. While the cognitive developmental viewpoint generally holds that social referencing emerges with cognitive abilities around 9 to 10 months of age, other researches (Vaillant-Molina & Bahrick, 2012) have show that under special environmental conditions involving intersensory redundancy, social referencing can be observed in children at 51/2 months. This suggests that social referencing is indeed a "hidden" skill – a behavior that is present in the child's repertoire but unobservable under typically occurring conditions.

In one experiment Pelaez, et. al., (2012) provided eleven 4- and 5-month-old infants and their mothers with a discrimination training procedure. Mother and infant joint attention to an ambiguous object was a required behavior. Different consequences followed infants' reaching toward an unfamiliar (ambiguous) object depending on the particular facial expression presented by their mother. During the training phases, after an infant referenced their mother's face, a joyful facial expression signaled positive reinforcement for the infant reaching for an ambiguous object, whereas a fearful expression signaled aversive stimulation for the same response. The research showed that mothers' facial expressions of emotion can be conditioned and acquired control over infants' approach behavior. Their findings underline that discriminative responding is necessary for the development of joint attention and social referencing skills.

Since skill learning is a hierarchical process depending on organismic and environmental factors, including skills learned earlier, it is not surprising that individuals with autism who show deficits in social referencing would also lack join attention and perspective taking. They may also develop significant delays in their social and emotional skills.

Most of the child's later social abilities such as reciprocal conversation, cooperative play, and displays of sympathy and empathy for others require the basics of joint attention and social referencing. Without these a child could not use the on-going cues of adults to determine how they are feeling and how to react (Pelaez, 2009). Hence, it is not surprising that children with autism, for example, who present deficits in social referencing subsequently, develop considerable delays in other social and emotional behaviors.

Social Skills and Stimulus Overselectivity

As noted earlier, the ability to respond discriminatively to complex stimulus arrays is an important skill that underlies learning in most behavioral domains, including language and social skills. Stimulus overselectivity describes behavior that is controlled by a single stimulus in an array of many stimuli. This type of "tunnel vision" (Rincover & Ducharme, 1987) has been reported in many, but not all autistic children (Lovaas, Koegel, & Schreibman, 1979). The research reviewed shows a correlation between stimulus overselectivity and autism. Stimulus overselectivity may contribute to autistic development in some children by interfering with normal social interactions, including early social interactions in which the child must respond to changing, but relevant facial cues that the mother provides.

Since the child responds to selective aspects of his/her environment, and because of the limited range of early interactive behaviors, stimulus overselectivity may be "hidden". Only later, when this overselectivity contributes to the failure to respond to other certain stimuli, more apparent deviations from typical development are observed such as "autistic aloneness" or "aloofness" At that point, rather than revealing the significance of overselectivity, the focus of our intervention should be on training more organized cusps, such as joint attention and social referencing.

When examining autism from a behavioral systems perspective is crucial to consider the behavioral systems concept of *coalescent organization*, in which a number of skills are assembled by reinforcing consequences into complex patterns of emergent behavior (Novak & Pelaez, 2004). This is consistent, for example, with how autistic persons often lack the ability to process faces configurally and rely instead on individual facial parts (Lahaie et al., 2006). The typical individual is able to recognize face parts based on the presence of concrete facial factors. When any of the prior components are missing (e.g., eye contact, scanning different areas of face), a child might not produce the desired behavior of configural face processing. Individuals with autism may not perform well on discrimination tasks involving face recognition. This could be because the holistic application of the aforementioned behaviors that is necessary for the pattern of producing perceptual observations are not yet learned, or because overselectivity to one part of the face would interfere with face-recognition which requires multiple stimulus control. In turn, failure to achieve person-appropriate face recognition interferes with the development of social reinforcement and appropriate social interactions.

Is important to clarify that in behavior analysis the diagnosis of autism is viewed as a summary label for a range of behavior excesses and deficits. As such autism does not exist as an entity. Autism involves naturally developing classes of organized patterns of behavior which are unique from individual to individual. The causes of autism are likely to be multiple, including long-term environmental interactions in conjunction with physiological and historical factors that are the legacy of interactions over time. In this paper we suggest some important cusps in normal and autistic development and note that some of these skills are central to development, but because they are not reinforced in typical developmental environments, they are "hidden" skills and not likely to be

observed in normal early social interactions. Yet, we also suggest that these behaviors normally result from environmental contingencies operating during early mother-child verbal and gestural communications (Pelaez, Gewirtz, & Wong, 2007) but may fail to develop in some children, especially those later diagnosed as "autistic". Furthermore, since these are "hidden" under normal circumstances, we suggest that specialized conditions be employed to assess whether or not the skills are there. The role of early and intensive behavioral interventions aimed at these hidden deficits needs to be highlighted. Behavior-analytic researchers have emphasized that learning history guides the emergence of these skills and have proposed interventions that promote the emergence of joint attention (Dube, MacDonald, Mansfield, Holcomb, & Ahearn, 2004; Holth, 2005; Holth, 2011) and social referencing (Pelaez, Virués, & Gewirtz, 2012).

It remains important to continue identifying other significant emergent behaviors called developmental cusps and to empirically and socially validate their contributions to the development and treatment of autism. These cusps are likely to be the result of the coalescence of skills both hidden and apparent in conjunction with physiological conditions and environmental contingencies. Early intervention that identifies skills and the developmental patterns that emerge are likely to lead to better outcomes than those that ignore a behavioral developmental perspective.

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