What the Savant Syndrome Can Tell Us About the Nature and Nurture of Talent

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Recent research has begun to illuminate the composition and development of exceptional skills in those with intellectual disability. I argue that this research is relevant to more general discussions of talent. First, it provides a special opportunity to deconstruct talent in different domains. Because savants typically lack the general intellectual skills usually present in those with more domain-restricted achievement, this analysis helps to delineate both the core components of talent in those domains and how more general skills affect the expression and development of that talent. Second, savants often have disabilities that can modify the direction of development in unusual ways. Examining these conditions suggests new ways of thinking about how talent may be nurtured.

Introduction

The "savant syndrome" typically refers to the presence of exceptional skill in the context of more general, occasionally severe, intellectual impairment (Miller, 1999). Savant skills are observed most commonly in music, the visual arts (primarily drawing), and in certain types of calculation (e.g., "calendar calculating"). The existence of savant behavior has been used as evidence for both "nature" and "nurture" positions in the debate about the origins of exceptional skill. For example, Gardner (1983) argued that the appearance of savant skill without any apparent direct tutoring in children with intellectual impairment indicates distinct varieties of intelligence. Moreover, the fact that these skills are often manifested at an early age suggests an important innate factor in their emergence. On the other hand, the observation that savants rehearse their skills extensively, sometimes obsessively (Howe, 1989), is used by proponents of a strong nurture position in the development of talent (Howe, Davidson, & Sloboda, 1998). Like the proverbial elephant being examined by blind men, the savant syndrome generates some conflicting conclusions about exceptional skill.

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In fact, perhaps the savant syndrome is simply irrelevant to discussion of the nature and nurture of talent. The developmental course and the kind of nurture seen in savants may be atypical. The young visual artist Nadia drew compulsively with any material available for several years, then lost both interest and technique, in spite of attempts to improve her drawing skills through formal instruction (Selfe, 1995). This does not fit easily into any traditional model of nurtured talent. Attempts to reproduce savant behavior by traditional techniques may produce a skill resembling those seen in savants (Ericsson & Faivre, 1988). However, it is by no means clear whether these cases capture the peculiarities of motivation and knowledge structure seen in savants.

Nor do savants present unambiguous support for nature versions of talent development. The early appearance of a skill is no guarantee that it is immune from environmental factors, given what we have discovered about infants' abilities to respond to and be affected by their environment. Nor, of course, does later emergence necessarily specify an environmental determinant. By itself, time of emergence is neutral, not necessarily implicating either environmental or genetic effects (Simonton, this issue). Furthermore, the savant syndrome may not lend itself to the kinds of behavioral genetic designs used to identify and evaluate hereditary and environmental contributions to variation in behavior. First, savants are quite rare. Assembling a sample with sufficient power to detect behavior-genetic linkages would be a daunting task. Second, savants typically have a variety of other physical and psychological impairments (Miller, 1999). It would be an additional challenge to assemble a sample sufficiently homogenous to permit strong inferences about etiology.

Nevertheless, I believe that a careful examination of the particulars of savant behavior and its developmental context can be useful to discussions about talent. Savant skills are, by definition, "splintered" or dissociated from the usual matrix in which one usually finds talent. This provides a special opportunity to deconstruct exceptional skill. Second, savants provide us with an opportunity to observe nurturing environments quite different from those found in traditional accounts of talent development. In doing so, they may enrich our ideas about the factors that affect that development. Let me expand upon each of these points in turn.

Savants and the Nature of Talent

A common distinction in the literature on exceptional skill is that between achievement restricted to a particular content area (e.g., mathematics) or activity (sculpture, musical performance) and more generalized skills associated with acquiring, organizing, and applying information across content areas. Gagné (1999) suggested that these latter skills reflect a more abstract problem-solving ability or processing capacity that is less amenable to, or affected by, direct instruction. Or, the distinction might be, psychometrically, between a general "g" factor linked to language and its role in human cognition and sources of individual variation in performance less dependent upon language (Tannenbaum, 1986).

Agreement on the distinction between general intellectual factors and specific skills is by no means universal. Howe et al. (1998) argued that the emergence of specific talent is merely the consequence of applying more general skills to a particular content area, the area chosen being a function of opportunity, parental pressure, exposure, and so forth. Complicating the issue is the empirical evidence of their association; individuals who show special talents in certain subjects or activities may also do well on measures of general intelligence (Lynn, Wilson, & Gault, 1989; Simonton, 1994). These correlations support the hypothesis that talent independent of more general factors is a fiction.

How does savant behavior fit into this framework? First, savants typically achieve, at best, only moderate levels of performance on measures of intellectual function outside their specific area of interest. Second, comparisons of savant accomplishments and their counterpart in those without impairment typically show that the skills in a given content area are broadly similar (Hermelin, 2001; Miller, 1989). The similarity seems strong enough to justify calling at least some savants prodigiously talented (Treffert, 1989). Thus, comparisons of savants and others in a given domain might be a way to delineate that part of exceptional skill that represents its point of contact with more general intellectual factors and that is independent of these factors (Hermelin).[1]

This suggests a detailed examination of individual savant behavior in the context of well-established norms of performance or with appropriate comparison groups in different content areas. This research has yielded tentative component skills important for the emergence of savant performance in different domains. Among musical savants, absolute pitch (Hermelin, 2001; Miller, 1989, Ockleford, 1998), aural melody retention and harmonic analysis (Miller, 1989; Ockleford, 1998; Sloboda, Hermelin, & O'Connor, 1985), and an ability to reproduce what is heard (Miller, 1989; Oe, 1995) have all been described as important component skills. Among drawing savants, visual memory, especially detail retention (Mottron & Belleville, 1995; Selfe, 1983); sensitivity to information specifying depth and perspective (Hermelin, 2001; Mottron & Belleville, 1995); and an ability to depict what is seen (O'Connor & Hermelin, 1987; Selfe, 1983) are common strengths. Among calendar calculators, event memory (Hermelin, 2001; Sacks, 1985; Young & Nettlebeck, 1994) and a tendency to attribute personal meaning to date and numerical information (Howe & Smith, 1988; Sacks, 1985) are often mentioned as significant factors. Given the relative rarity of research in this area, of course, these lists are tentative. Still, they suggest that these kinds of building blocks to exceptional skill may exist independent of more general levels of cognitive achievement.

Examination of savant skills also suggests some anomalous weaknesses. For example, O'Connor and Hermelin (1987) found that drawing savants' reproductions of figures from memory were as accurate as those of gifted artists without mental impairment, while their ability to recognize a previously seen figure was no better than that of a comparison group with mental retardation. Miller (1989) reported that musical savants may have difficulty with simple discrimination judgments ("same vs. different") on successive tones, though they may be able to identify these tones independent of context, so-called absolute pitch. Both cases apparently represent a variation of the usual developmental sequence in which recognition and discrimination are typically much more advanced than reproduction within a perceptual domain (Flavell, Miller, & Miller, 1993).

Second, in their exercise of savant skills, savants employ a strategy quite different from those without intellectual impairment. Mottron and Belleville (1995) observed two peculiar features in the visual reproductions of a savant artist. While depictions of depth and layout did use the linear perspective common to more sophisticated styles of drawing, its application to the objects and surfaces within a portrayal did not suggest a common vanishing point and, hence, a well-articulated point of view. Second, drawings tended to follow a "proximity" rule of completion, rather than one specifying a broad outline or contour that is subsequently subjected to elaboration and correction.

Hermelin (2001) argued that such anomalies as these indicate a "weak central coherence" (p. 45) in savants similar to that postulated by Frith (1989) as a frequent characteristic of those with autism. Without a general conceptual framework for processing and organizing information, several problems emerge. Inconsistencies across parts of an array or event reproduction might be difficult to detect or resolve. Second, reproductions may be highly accurate at the local level, though not particularly well adapted to the context. To some extent, difficulties in making simple same-difference or delayed recognition judgments may similarly reflect the unavailability of more general frameworks for processing information. Even simple same-difference judgments depend upon shared general criteria for determining what constitutes a "significant difference." Finally, lacking the resources to form more comprehensive and well-integrated representations of a domain, savant skill expression is more likely to be idiosyncratic with respect to either style or subject matter. Among savant visual artists, visual layout and depictions using prominent linear perspective are frequent strengths. Among savant musicians, the keyboard is overwhelmingly the favorite instrument, and aural memory for melodic line and harmony the most common strength.

This circumscribed domain of savant skill expression has been remarked upon by others (Howe et al., 1998; Winner, 2000). Howe et al. suggested that this may be simply a matter of extensive exposure and material availability. If paper and pencil are readily available, the budding visual artist's expression is likely to involve pictorial depictions of one's visual environment (Selfe, 1977). However, savant musicians' preference for keyboards cannot be a simple matter of availability. Savant percussionists are not common, though instruments for rhythmic elaboration are probably the most readily available across cultures. Language is certainly a prominent part of the human environment, but savant skills in this domain are quite rare (Hermelin, 2001; Smith & Tsimpli, 1995).

Elsewhere (Miller, 1989) I have argued that congruence between keyboard layout and the structure of much (Western) music of the past 300 years may be particularly helpful to the savant in accessing musical structure. Thus, octaves and other intervals central to music from the "common practice" period are prominent in the spatial layout of keyboards. Moreover, these may have an intimate relation to the regularities inherent in sound production in the environment and its perception by the human listener (Krumhansl, 1990). These regularities suggest both a hierarchy for ordering pitch information (the primacy of the intervals, the octave, and the fifth) and some simple rules relating pitch classes (pitches with shared overtones "belong together," etc.) Even novices with some interest in music can discover these relationships in simple piano keyboard exploration (Miller & Orsmond, 1994).[2] Similarly, the use of linear perspective by visual artists relies upon a well-established set of rules for depicting depth information on a two-dimensional surface, rules that are implicit in the visual layout and likely embedded in the encoding of layout information by the visual system (Hagen, 1986). Calendar calculating, a favorite kind of mental manipulation and memory skill in savants, takes advantage of a highly structured, self-contained domain, the Gregorian calendar (Spitz, 1994). Thus, the areas in which savants are likely to express exceptional skill are those in which strong structure is embedded within the content area itself. Moreover, in at least two cases, music and visual art, the structure seems to be intrinsic to the processing of information by the typical listener or observer; and there is at least partial isomorphism between this structure and cultural conventions of representation (e.g., scene depiction, harmony.) To this extent, these types of skill may flourish without the central coherence posited by Hermelin (2001). Exceptional sensitivities in modalities other than vision and audition have been described in those with disabilities (O'Neill & Jones, 1997). However, equivalent savant performance in these modalities is virtually nonexistent. Perhaps the absence of structural analog, like those ascribed to vision and audition, hinders further representational elaboration of this sensory information in those with general intellectual impairment.

Finally, variations in skill among savants may be less dependent upon variations in general levels of intellectual achievement for some areas than others. Miller (1989) and Selfe (1983) described exceptional skill in music and the visual arts, respectively, in cases with very low general intelligence as assessed by conventional instruments. On the other hand, variation in either the extent of calendar calculating knowledge or the ability to apply that knowledge to novel situations was found to be related to IQ in several samples (Hermelin & O'Connor, 1986; O'Connor, Cowan, & Samella, 2000).

In summary, the evidence for skill components in savants suggests these can be manifested independent of more general intellectual achievement. Further, research suggests that the extent to which general intellectual factors moderate exceptional achievement depends upon the domain. Future research might profitably examine linkages between various skill components and broader competencies within each domain (e.g., O'Connor et al., 2000; Tsimpli & Smith, 1998). The delineation of skill components in savants also can provide target behaviors for the kinds of behavior genetic designs that are not feasible within the savant population. For example, absolute pitch, which has emerged as a common feature among musical savants (Miller, 1989), has recently been the subject of research designed to detect genetic factors in its appearance in those without disability (e.g., Baharloo, Service, Resch, Gitschier, & Fremier, 2000). Examination of savants also points to anomalies in skill expression and notions, such as central coherence, and represents interesting hypotheses about how component skills may be organized (or, in the case of savants, not organized) in the attainment of exceptional achievement. The extent to which central coherence represents a dimension of knowledge content (Hermelin, 2001), hierarchical organization (Mottron & Belleville, 1995) and personal cognitive style (Happe, 1995) remains an important question. Answers to this question would help clarify how exceptional achievement emerges from early interests and precocious behavior.

Savants and the Nurture of Talent

Simonton (1999, this issue) has noted that a viable theory of exceptional skill must offer an explanation for its relative rarity. His attack on this issue assumes that instances of exceptionality result from the presence of multiple components interacting in a nonadditive fashion. Thus, if even one of these components is missing, exceptionality may not be expressed. From this perspective, the presence of savant behavior at all should be a surprise, given that, by definition, savants have significant disabilities of some sort and so would be more likely to be missing some component necessary for skill expression.

However, an examination of the developmental context of savant behavior suggests it may actually be promoted by certain kinds of disability. The notion that disability might somehow nurture savant behaviors is certainly not new. Early accounts of savants have suggested that the physical and mental deprivation associated with their disability might prompt some individuals to fixate on one activity to the exclusion of everything else (Lindsley, 1965). In fact, isolated, highly ritualized behaviors are fairly common in those with disability (Bodfish, Symons, & Parker, 2000), especially under conditions of environmental deprivation. However, these stereotyped behaviors may, in fact, be inimical to the establishment of more conventional interests and modes of expression.

A different sort of link between disability and skill is suggested by recent research on the consequences of sensory loss. For example, severe congenital visual defects are often present in musical savants (Miller, 1989, 1999). Congenital blindness is associated with the presence of absolute pitch (Welch, 1988) and other aural skills (Miller, 1992) that are prominent components in musical savants' achievements. Work with animal models (e.g., Sur & Learney, 2001) suggests that early sensory loss results in expanded registration of input from intact senses in those cortical areas usually dedicated to input from the (peripherally) disabled sense. Moreover, the functional organization of these "rededicated" areas is, to some extent at least, determined by the structure of the input they receive.

Absolute pitch may also be more common in those with autism (Heaton, Hermelin, & Pring, 1998) or as a consequence of certain kinds of training (Crozier, 1997) independent of sensory loss. In the former case, the absence, or at least the reduced prominence of conceptual structure, particularly that available in language, may promote attention to different features of auditory information. In the latter case, formal training directs attention to identifying those features (e.g., pitch classes rather than intervals) deemed especially useful in encoding and retrieving aural music. Snyder and Mandy (1997) have argued that a similar effect may occur in the visual modality. That is, in the absence of the recoding afforded by conceptual knowledge about objects, savants' reproduction of physical detail might be enhanced.

At this point it is not clear whether differences associated with sensory loss bear more than a superficial resemblance to those associated with cognitive impairment. It is also not clear to what extent these types of reorganization affect the qualia of sensory experience, as well as the cortical resources devoted to their interpretation. More detailed examination of the nature of cortical activity during processing, as well as the behavioral correlates of these functionally reorganized systems, would help to clarify these issues. In any case, these results suggest loss or impairment may affect the component expression found in exceptional skill, as well as the probability that the skill will emerge.

Though there are often indications of early and precocious interest in the personal histories of savants (Miller, 1999), the course of skill development may still be lengthy. Simonton (1999) has argued that the slowed rate of development associated with mental impairment may have several consequences. It may extend both the time period in which exceptional skill is likely to emerge and its susceptibility to formative interventions. For example, the composer Hikari Oe expressed exceptional interest in the sounds of nature, particularly bird calls, at a very early age. It was only after a considerable time, however, that the extent of his ability to name and mimic these sounds was manifested. Similarly, early interests in music did not translate in a straightforward fashion into precocious musical performance; in fact, Oe's performance skills remain modest, at best. However, his parents' dedication to finding the proper avenue for building upon this musical interest eventually led to critical experiences with a music teacher sensitive to his interest in composition. Impressive achievement in composition eventually emerged (Cameron, 1998; Oe, 1995).

Finally, the history of personal success (and failure) in helping savants highlights the importance of exploring alternative pedagogical devices in skill enhancement (Mottron & Belleville, 1993; Selfe, 1995). For many musical savants, early stages of skill development are characterized by intense listening, followed by self-directed trial-and-error reproduction of what they have heard. Ockleford (1998) suggested that this early history may have several pedagogical consequences. First, the idea of formal training may be quite foreign to the young savant, and any attempts at instruction may be rejected through simple failure to understand the context. Second, highly idiosyncratic styles of performance may already be established by the time formal training is attempted. These factors require modifying traditional techniques in the direction of greater student initiation of the musical "agenda" for rehearsal and less reliance upon expository means of instruction. According to Spitz (1995), while calendar calculators may benefit from formal introduction to calendar structure, more often knowledge about structure is acquired through implicit pattern recognition with repeated examination of day-date information. It is likely such implicit learning is also part of the growth of exceptional skill in those with no disability (Bamberger, 1982; Chaffin, Imreh, & Crawford, 2002; Morelock & Feldman, 1993). Savants may provide a special opportunity to observe the process and products of this learning.

It is very rare for a savant to reach levels of achievement equivalent to that of their nondisabled peers, and examination of what appears to be limited in savants suggests why this may be so. Thus, among those without disability, the implicit "intuitive" acquisition of information is typically accompanied by more formal and explicit types of representation, at least at more advanced levels of skill development (Bamberger, 1982; Morelock & Feldman, 1993). Morelock and Feldman suggested that self-reflective and metacognitive capacities often associated with general intelligence allow child prodigies to perfect their talent. However, as noted earlier, the absence of these formal representational capacities in savants means that their special talents are likely to remain truncated. Such factors as limited central coherence as described by Hermelin (2001) may also impose serious problems for skill enhancement. One can imagine, for example, that musical development not closely integrated with other aspects of one's experience might lack the depth and nuance found at the highest levels of performance. This presents an additional pedagogical challenge to those wishing to provide the optimum nurturing environment for those both talented and disabled.

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Endnotes

1. This reasoning is viable for those cases in which there is well-documented intellectual impairment in the savant sample. Definitions of savant syndrome occasionally include intellectual impairment, adaptive impairment, or both as the qualifying disability.

2. It is probably no coincidence that Hikari Oe, the successful savant composer, prefers to compose within the stylistic regularities of the classical period (Cameron, 1998).