Sounding Off: Theorizing Disability in Music

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10

Using a Music-Theoretical Approach to Explore the Impact of Disability on Musical Development: A Case Study

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Introduction

This chapter presents a preliminary exploration of how disability—in this case, congenital blindness—can impact on musical development using the music-theoretical approach to the cognition of musical structure set out by Ockelford (2002, 2004, 2005a, 2005b, 2006). The impact is shown to be twofold: direct, stemming from the effects of visual disability on auditory development—in particular the processing of musical sounds; and indirect, resulting from the attitudes of others to severe sensory loss and the confused expectations that can arise as a consequence. Hence, this chapter draws on both the medical and the social models of disability, aiming to fuse the two within an integrative paradigm as described, for example, by Seelman (2004).

A case-study method is adopted, in which a vocal improvisation by a four-and-a-half-year-old girl (called K here to protect her identity) with septo-optic dysplasia[1] that was previously videoed and transcribed (Ockelford et al. 2006), is analyzed in relation to two dimensions: (1) intrinsic coherence and expressivity; and (2) the influence of the contemporaneously improvised accompaniment. The identified implicative relationships connecting differing musical elements within and beyond K's improvisation offer a unique insight into her evolving musicality, provide evidence of how this may have been influenced by her congenital disability, and, it is suggested, may even serve as proxy measures of her social interaction in the context of music-making.

The findings bear upon a range of contemporary issues in music and disability studies, including the distinction between music education and therapy for children with disabilities (Ockelford 2000; Robertson 2000), the potential for exceptional musical development in the context of disability (Miller 1989; Treffert 2000; Ockelford and Pring 2005), and the significance of this exceptionality for a wider understanding of musical ability (Obler and Fein 1988). Moreover, it is anticipated that the new technique for analyzing improvised

musical material with two participants or more will be of value in a range of therapeutic, educational, and music-analytical contexts.

Current Research into the Musicality of Children with Septo-Optic Dysplasia

An initial investigation into the musicality of children with septo-optic dysplasia was undertaken by Ockelford et al. (2006), who elicited the views of their parents and caregivers in the United Kingdom and the United States via a questionnaire. These accounts were contextualized through comparison with a further group of children, matched as far as possible by age and sex, with no known special educational needs. The findings of the study showed that, in the opinion of parents, blind children are significantly more likely than their fully sighted peers to have a particular interest in music and to find it important as a source of stimulation or comfort, for communication or for socialization or understanding or to mark out events in their daily routine. Moreover, it seems that they have a tendency to display exceptional musical abilities, including the possession of absolute pitch (AP)—the faculty of recognizing and reproducing notes in isolation from others. This capacity is extremely rare in Western populations as a whole, with a prevalence estimated at only 1 in 10,000 people (Takeuchi and Hulse 1993). Among those born with little or no sight, however, the position appears to be rather different. Welch (1988), for example, noted that twenty-two out of thirty-four blind children in special schools with which he came into contact had AP (65 percent), while Ockelford (1988) reported that nineteen out of fifty children (38 percent) in a London special school who were born blind or who had lost their sight shortly thereafter had unusually highly developed pitch-recognition abilities.[2]

With regard to those with septo-optic dysplasia, the findings of the 2006 survey are necessarily preliminary in nature, since they rely on indirect evidence of the children's musicality provided by others. The next step is to interrogate the musical production of some of these children directly, a research objective for which this chapter provides contributory evidence by providing an account and analysis of an interactive music session that K had with the author (hereafter AO).[3]

The Session with K

The session was originally intended to assess K's musical development and was triggered by her class teacher's observation that she particularly enjoyed singing and that, as far as the teacher was able to judge, her efforts appeared to be unusually advanced for a child of her age. It was known, too, that K had a small keyboard at home, which according to her parents kept her occupied for substantial periods of time even though she had never received any formal music instruction. What, then, were the scope and nature of her musical abilities and potential? And, more broadly, did K's musical development

support the notion that some children with septo-optic dysplasia may display exceptional musicality?

The session began with AO suggesting that K might like to sing something, and she immediately set off unaccompanied with an up-tempo version of "Supercalifragilisticexpialidocious" from *Mary Poppins*. K's singing was characterized by a raucous enthusiasm. Despite the limitations of her vocal technique, which meant that her intonation was not always perfect, K's rendition had a secure tonal center (the key of D), which was established without a pitch reference. K evidently relished making music with someone else present, and she was happy to repeat the song with great gusto at an even faster tempo, this time with the piano in attendance.

Here, then, was a natural and uninhibited young performer who loved to make music and could communicate forcefully through sound. The fact that her rendition began recognizably in the key of D major[4] and remained in that key—notwithstanding the immaturity of her vocal production—indicated that K was very likely to have AP, lending support to previous findings that congenital blindness is a strong predictive factor in the development of absolute pitch perception, a positive musical corollary of this type of disability. In addition, K evinced a secure sense of rhythm that was flexible enough to accommodate different tempi. However, a number of issues remained to be resolved. For example, how effectively was K able to process harmony? Was she able to create her own music? And if so, at what level was she capable of assimilating and developing given material and fashioning this into a recognizable structure within a coherent stylistic framework? As her disability appeared to have had an impact on her perception of pitch, did its influence also extend to these other areas of musical functioning, directly or indirectly—for example, through constraints generated by the attitudes and expectations of others? And if so, could steps be taken to ensure that such barriers did not impede her future progress?

AO first sought to address these questions by suggesting that K make up a new song—perhaps about her pet dogs, Jack and Elisha.[5] Four chords—F major, D minor, G minor ninth, and C major—were presented on the piano with a gentle swing rhythm, and a simple vocal melody was added to set the scene. After only two iterations of the sequence, K took the lead and, against the continuing four-chord ostinato, made up a song that lasted for one and one-half minutes (see Figure 10.1).

This improvisatory approach, which was intended to be child led, arguably owed more to the thinking that typically underlies music therapy than that usually encountered in music education (see, e.g., Bruscia 1987, 1989). However, as Ockelford (2000) observes, music therapy and music education sessions for children with disabilities may well overlap a good deal in terms of approach and content, with the aims and objectives of the teacher or therapist accounting for the main differences between the two. Hence, although the

session under discussion here took place within an educational context, the musical analyses that follow later in this chapter offer insights of potential interest to therapists too.

As the accompanist, AO's initial impression of this song was of an unfolding extemporization of startling moment-to-moment expressivity within a continuously evolving but coherent musical structure. Behind it, evidently, lay an active musical mind capable of creating new material intuitively, quickly, and confidently within a familiar style. Beyond these contemporaneous reactions, however, the taped record of the session made it possible to transcribe and to analyze K's efforts systematically in relation to a number of criteria, which enabled aspects of her musical development to be profiled and the possible impact of her disability on these to be gauged. The criteria were developed



Figure 10.1 K's improvisation on "I Have a Dog."



Figure 10.1 *Continued*

from the author's theory of how music intuitively makes sense and can convey meaning (Ockelford, 2005a, 2005b). An introduction to this zygonic theory follows.

Zygonic Theory: An Introduction

According to zygonic theory, musical coherence is based on a sense of derivation, whereby a given aspect of musical sound—a particular pitch, harmony, tonality, inter-onset interval, duration, or meter, for example—is felt to imitate another, something that typically occurs nonconsciously. Each of these features has the potential to induce a range of emotional responses, and the sense of derivation that exists between them enables a kind of abstract aesthetic narrative to be built up in the course of listening to a piece, rather like hearing a story devoid of concrete meaning.[6]

The cognition of derivation between musical elements is predicated on the presence of interperspective relationships[7]—cognitive constructs through which, it is hypothesized, percepts may be compared (cf. Krumhansl 1990, 3). Interperspective relationships may be regarded as forms of "link schemata" (Lakoff 1987, 283), which inhabit the mental space pertaining to music processing (Fauconnier 1994).[8] Such relationships potentially exist between any features of musical events. In most circumstances they are formulated unthinkingly, passing listeners by as a series of qualitative experiences. However, through metacognition, interperspective relationships may be captured conceptually and assigned values, commonly expressible as a difference or ratio.

Figure 10.2 shows interperspective relationships symbolized by an arrow with the letter I superimposed. Superscripts indicate the features concerned, each represented by its initial letter (P, pitch; O, onset). Relationships can be of different levels, with primary relationships potentially linking percepts directly, secondary relationships connecting primaries, and tertiary relationships comparing secondaries (Ockelford 2002). The level of a relationship is indicated by the appropriate subscript (here, 1 in each case). The values of the pitch relationships, shown near the arrowheads as –m3, have two components: polarity, which here is negative, showing that the intervals are descending; and magnitude, a minor third. Similarly, the values of the relationships of onset indicate both temporal polarity and magnitude, a dotted eighth note.[9]

Interperspective relationships through which imitation is cognized are deemed to be of a special type, termed *zygonic* (Ockelford 1991, 140–160).[10] Zygonic relationships, or *zygons*, are depicted using the letter Z. In Fig. 10.2, the primary zygonic relationship of duration, D, reflects the apparent derivation of the note-length used for the word "as" from that pertaining to the preceding "Jack." The secondary zygons of pitch and onset, indicated through the subscripts 2, show imitation at a more abstract, or intervallic, level. Observe the use of full arrowheads, which signify relationships between values that are the

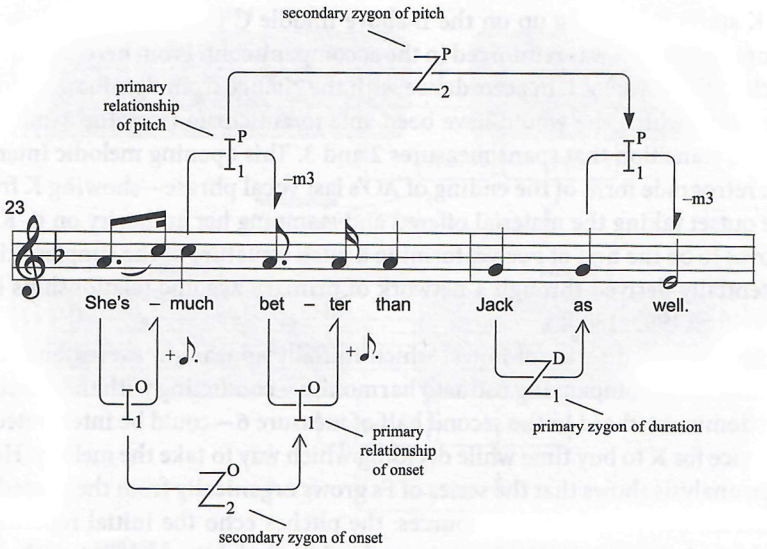


Figure 10.2 Zygonic analysis of mm. 23–24.

same. Half arrowheads are indicative of difference and are used in a zygonic context to show approximate imitation.[11]

This theoretical framework is used to analyze K's improvisation in relation to the two principal sources of material on which she was potentially able to draw: (1) the unfolding melody, as initiated by AO and subsequently taken up by K; and (2) the piano accompaniment provided by AO. The light these analyses shed on the relationship between K's musical abilities and her disability are considered in the course of the discussions that follow.

Analysis of K's Song

Internal Coherence and Expressivity

With regard to the improvised song melody, the first question to be addressed concerns its cogency: Does it make musical sense—and, if so, through what structural means? Zygonic theory holds that musical coherence requires at least one salient feature from each event to derive from another or others.[12] A full zygonic analysis of K's song, which is too extensive to be reproduced here,[13] shows that this is indeed the case, confirming the informal observation that successive notes do not pass by as isolated entities but sound logically connected to each other through similarities in pitch or rhythm that bind them together in the mind to form short melodic chunks. As is shown here, these chunks are themselves linked through various forms of sameness and similarity. Here, an analysis of K's first phrase suffices to illustrate the principles involved (see also Figure 10.2).

K starts by picking up on the E above middle C that AO's vocal line left hanging and that was reinforced in the accompaniment. From here, she moves back to the adjacent F in accordance with the change from dominant to tonic harmony, which she would have been able to anticipate from the same harmonic transition that spans measures 2 and 3. This opening melodic interval is a retrograde form of the ending of AO's last vocal phrase—showing K from the outset taking the material offered and stamping her authority on it. K's F proves to be the first of twelve, forming a pitch structure of the simplest kind, potentially derived through a network of primary zygonic relationships (see Ockelford 1993, 180 ff.).

This repeated series of notes, which initially appears to overextend itself against the accompanying ostinato harmonies—conflicting with the concluding dominant chord in the second half of measure 6—could be interpreted as a device for K to buy time while deciding which way to take the melody. However, analysis shows that the series of Fs grows organically from the preceding material, deriving from two sources: the pitches echo the initial repetitions of the melody, and the rhythm adopts the dotted-eighth-note–sixteenth-note pattern first heard in the second half of measure 2. Hence, K took two distinct elements from the opening phrases of the melody—supplied by AO—and fused them in her continuation, a form of musical development typical of many styles that simultaneously offers coherence and variety. K's forceful delivery of the repeated pitches adds to the sense that she is asserting her place in the partnership about to unfold: both musically and socially, building a foundation for the action to come.

This kicks off immediately: In the very next phrase (measure 7), there is a sense of release as K's melody springs up from the constraints of the opening repetitions using a new syncopated rhythm. Despite the feeling of things moving off in a new direction, both pitch and rhythm again derive logically from what has gone before: The dotted motive is once more pressed into service, and two similar ascending melodic intervals—from F to A and from A to C—were deployed to straddle the two phrases. This method of connecting chunks—through secondary zygonic relationships rather like using a musical ladder to link different ideas—is one K adopts a number of times—for example, between measures 16–17 and 22–23 (see Figure 10.3). Her other favored approach is to use a primary zygonic relationship—taking a pitch at or near the end of a phrase and using it to start the next: See, for example, the connections between phrases in measures 8, 18–19, and 20.

These two ways of connecting musical chunks are characteristic of many musical styles (Ockelford 2004). However, there is another way of linking segments: through the repetition, or variation, of chunks as a whole, arguably the most widespread of all music-structural techniques yet one K does not use. The nearest she gets to it is in measures 17–24, when a pattern of three descending pitches is successively transposed and varied, mirroring and enhancing the

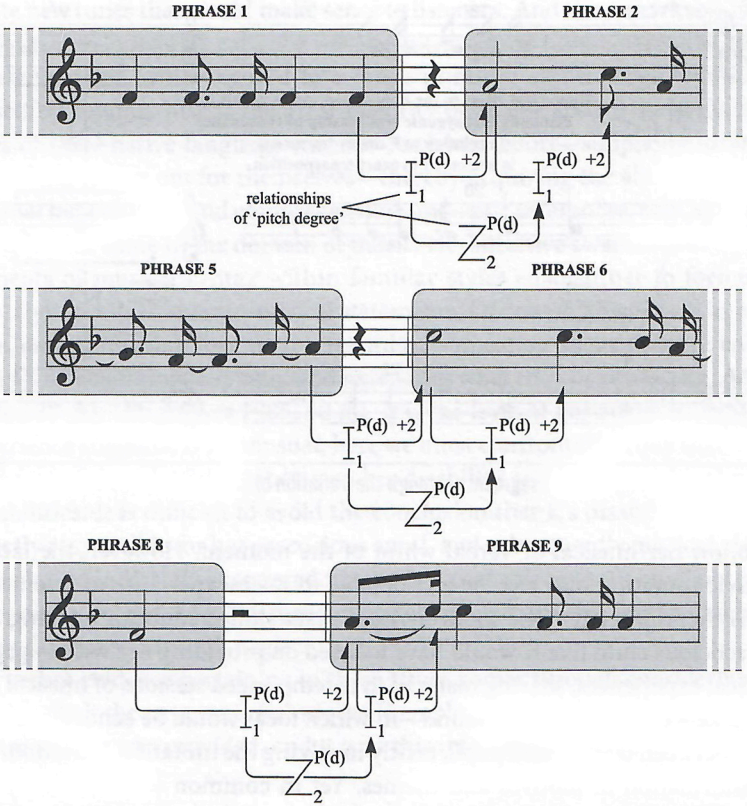


Figure 10.3 Connecting melodic chunks through secondary zygonic relationships.

rhetorical form of the verbal narrative at this point: "one for her biscuits, one for her water, and one for her meat" (see Figure 10.4). Exact transposition of the intervallic descent, which would have required a B-flat at the beginning of measure 19, appears to have been overwhelmed by K's desire for a convincing concord at this juncture, with the emphasis on the repeated word *one*. Thus, K demonstrates the intuitive ability to weigh up and to manage conflicting musical—and extramusical—demands and, in the midst of her improvisation, the capacity to select the option best suited to her expressive intentions.

Why is the commonplace method of repeating or varying chunks as a whole not utilized more? It may be a consequence of the improvised nature of the exercise that K was undertaking, in which building a coherent structure depended on remembering material that had just been made up at the same time as continuing with the creative process—which may well have interfered with the memories that had recently been formed. By intuitively adopting the approach of having each successive chunk pick up where the previous one left off, K made fewer demands on her memory and gave herself greater freedom

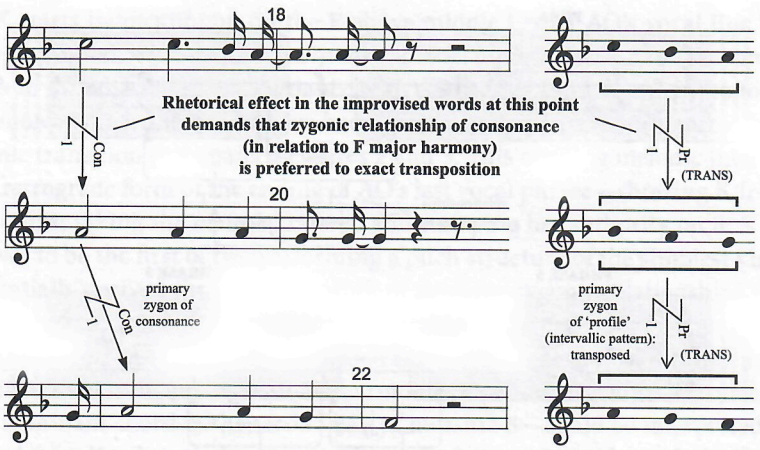


Figure 10.4 Linking melodic segments through the variation of chunks as a whole.

to follow her musical or verbal whim of the moment. However, the lack of motivic imitation may also be attributable to K's inexperience of interacting with other musicians. One could envisage that a skilled educator working with a precocious child like K would have focused on providing her with engaging musical experiences, sharing material in extemporized sessions of musical give and take—conversations in sound—in which ideas would be echoed back and forth between teacher and pupil, tacitly involving the imitation, variation, and transformation of motives and themes. Yet in common with all thirty-two children with septo-optic dysplasia in Ockelford et al. (2006), K had never had specialist music lessons. Ockelford, Welch, and Pring (2005) hypothesize that the lack of formal musical intervention in the lives of these young people may be accounted for by the unduly low expectations of their musical learning and achievement that their disability engenders in those around them. If this is true, then it could be argued that attitudes to K's disability had had a negative impact on aspects of her musical development up to this point.

A corollary of K's free-flowing approach in her improvisation is that there is no particular pattern to the links between chunks in her song: Though the moment-to-moment connections on the musical surface are convincing enough, there is no hierarchical arrangement of the segments—no deeper structural repetition or development. The climax, which occurs at the end of the improvisation, is signaled by a change of register and effected through a high, sustained tonic F (sung *fortissimo)* rather than occurring through a feeling of structural inevitability. Again, this may in part be due to her lack of experience in making music with others and so ultimately be attributable to attitudes to her disability. Nonetheless, K's song shows that she had grasped some of the key principles of how music—in the Western tonal vernacular of the early twenty-first century—is structured and that she could use these to

create new tunes that would make sense to listeners. And the remarkable thing is that K developed this capacity with no intervention on the part of others—purely through being exposed to a range of music and through expressing herself by singing. Just as the great majority of people absorb the syntactical rules of their native language without conscious effort—simply by listening and trying things out for themselves—thereby acquiring the ability to create original but coherent and comprehensible linguistic utterances, so K evidently had done the same in the domain of music. Her intuitive awareness of certain elements of musical syntax within familiar styles enabled her to formulate new, stylistically authentic musical statements. Of course, this is not, in principle, exceptional; almost all young children make up songs that are coherent just by absorbing, copying, and extending what they hear (see, e.g., Moog 1976, 128–33; Hargreaves 1985, 60 ff.). It is the level of her achievement that, experience suggests, is so unusual; here we must confront the irony that lies at the heart of the relationship between her disability and her exceptional musical abilities. It is difficult to avoid the conclusion that K's disability was both directly responsible for her precocious aural, and subsequently musical, development and indirectly accounted for the fact that this potential had not been recognized, celebrated, challenged, or extended and, indeed, was in danger of being dissipated through neglect.[14]

Further evidence pertaining to these issues comes through considering the way in which the structural techniques K employed interacted with the accompaniment that was provided, and it is to this interaction that we next turn our attention.

Influence of the Accompaniment

The theory that musical structure stems from the derivation of material through imitation was used to gauge the impact of the accompaniment on K's creative efforts by assessing each note[15] in relation to its probable musical sources, which could be found either in AO's initial melodic thread (measures 1–4), the extemporized piano melody (equivalent to the uppermost RH notes), the LH ostinato bass, or K's vocal line.[16] For every note, up to ten zygonic relationships[17] were considered in relation to pitch, melodic interval, harmonic context, and rhythm. These were weighted as follows: Pitch scored 2 for exact repetition and 1 for the transfer of pitch class to a different octave; melodic interval scored 2 for identity, 1.5 for approximate imitation, and 1 for inversion or retrogression; harmonic context scored 2 for exact repetition, 1.5 for variation, 1 for transposition, and 0.5 for transposed variation; and rhythm scored 4 for identity, 3 for approximate derivation (including a change of relative location within the relevant metrical level), 2 for repetition of duration or inter-onset interval only, and 1 where the sole connection was the variation of duration or inter-onset interval. Since each aspect of every note could be considered to be derived from up to ten others, further weighting was necessary

whereby each raw score of derivation strength was multiplied by a factor based on the theorized salience of the zygonic relationship concerned such that the sum of the factors pertaining to the given feature of a particular note was invariably 1.

For example, K's seventh pitch, labeled K7 in Figure 10.1, could be considered to derive from K6, K5, K4, AM13, K3, K2, AV12, AM11, AV11, and AM10—the order determined by their temporal adjacency to K7.[18] The pragmatic decision was made to separate each of the factors used to moderate the raw scores pertaining to a series such as this by a common difference (implying a linear decrease in the strength of their zygonic influence). In this case, with ten factors required, the values used to modify the raw derivation scores were 0.182, 0.164, 0.145, 0.127, 0.109, 0.091, 0.073, 0.055, 0.036, and 0.018, respectively. The result of applying these proportions to the raw scores was a series of derivation indices.

The indices for each feature were summed separately in relation to the material improvised by AO and K. The total potential derivation index for each note ranged between 0 and 10 from either of the two sources (AO or K). With regard to K7, the subtotals pertaining to AO- and K-derived material are as follows: Pitch has a derivation index of 0.618 from AO and 1.382 from K; melodic interval, 0.334 from AO and 1.666 from K; harmonic context, 1.335 from AO and 0.666 from K; and rhythm, 1.620 from AO and 2.136 from K. This yields a total derivation index of 3.907 from AO's material and 5.850 from K's. Given the maximum total derivation index of ten, the sum of these two figures (9.757) leaves a residue of 0.243, reflecting aspects of K7 that cannot be accounted for through derivation from other material in the song. This, then, is a measure of the originality of the event in question (K7) in relation to the improvisation up to that point.[19]

The usefulness of these figures in interpreting the relationship between AO's and K's contributions lies principally in the ratios between them—taken either as averages over a given period or in terms of event-by-event patterns of variation. For example, seventy percent of AO's production was generated from other of his own material, with a little under 13 percent deriving from K's input. In contrast, only 50 percent or so of K's melody is attributable to the emulation of her own efforts, with approximately 36 percent based on AO's introductory vocal melody and piano accompaniment. This is powerful evidence that, although improvising her own structurally and expressively coherent melody, K was able to attend to the piano accompaniment and—apparently without conscious effort—to take on board a range of presented musical ideas. Moreover, within the musical interaction that occurred, AO's influence on K was almost three times greater than K's impact on AO—a somewhat sobering statistic for a music educator who at the time felt he was providing a responsive foil for K's efforts. In fact, zygonic analysis indicates that the flow of musical ideas was largely from teacher to pupil. The derivation indices also enable us

to track how the influence of one performer on another varied over time. For example, during K's first phrase (notes K1–K13), the derivation index from AO's material falls from 9.476 to 0.927, whose trend closely matches a linear descent ($R^2 = 0.8155$)—the principal exceptions being K9 and K10, where K introduces a rhythmic pattern similar to one used in AO's introduction (see Figure 10.5). This decline in K's use of AO's material through the phrase reflects K's increasing self-assertion (noted previously) and, as one would expect, is matched inversely by an increasing use of her own improvisation to generate further ideas.

Subsequent phrases show different derivational patterns that cannot be reported in detail here. However, the mean derivation indices pertaining to phrases are used to give an overview of trends at a deeper structural level. These show K drawing significantly on AO's material in her first phrase, less so in the second, and more again in the third and the fourth. Subsequently, there is a gradual decrease in AO's impact over phrases five to nine—the central part of K's improvisation with the descending sequence at its heart—during which K's efforts become ever more self-sufficient. In contrast, AO's influence is felt more strongly in K's tenth phrase, whose lack of verbal coherence suggests that K may have been running out of steam. Indeed, after rallying briefly in the eleventh phrase, K's creative flow almost completely dries up at the beginning of the twelfth, and she draws heavily on material in the accompaniment to sustain her vocal line, although in the concluding notes she finally wrests back the initiative. K's global pattern of derivation from AO, invariably lower than AO's derivation from K, is inversely related to it with a striking

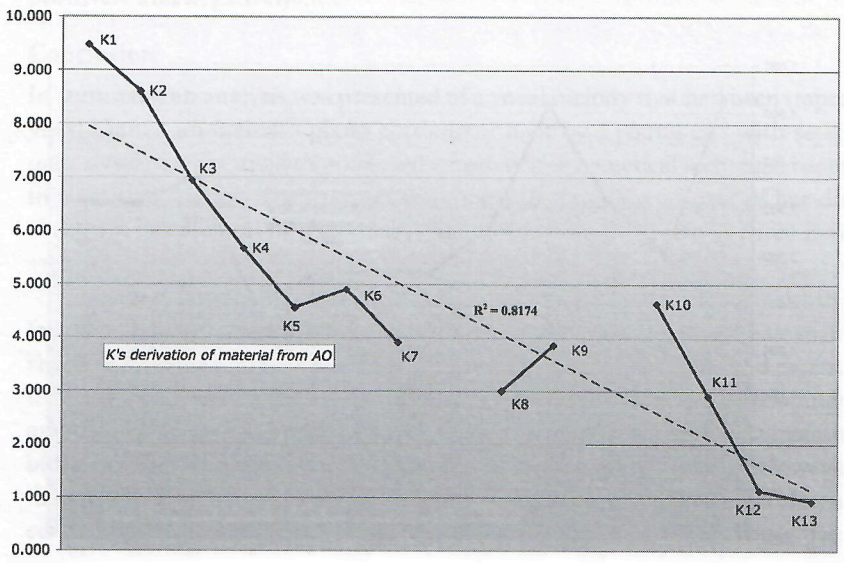


Figure 10.5 The influence of the accompaniment: the derivation of material through imitation.

consistency (82 percent). That is to say, during the improvisation as K chose to rely less on AO for material, AO tended to rely more on K and vice versa—perhaps through an intuitive desire on the part of one performer or both to ensure coherence in the improvised texture as a whole (see Figure 10.6).

Analyzing indices of originality reveals further issues of structural significance. For example, in K's events that had an originality index ≥ 0.25 (i.e., when a quarter or more of the material was derived other than from the improvisation (of which there are thirteen such events: K12, K14, K15, K17, K27, K28, K35, K49, K91, K92, K94, K103, and K104), her originality is most frequently expressed in the domain of harmonic context (in 62 percent of cases). On some occasions, this appears to be the result of K's melodic intent overriding the harmony provided (e.g., in the second half of measure 6 and at the end of measure 10), although her continuations make sense of these things in retrospect: As has already been observed, the repeated Fs in measure 6 serve as a springboard for the next phrase, whereas the F at the end of measure 10 is sustained to reach over into the F major harmony that starts the next sequence. However, at other times, rather than having arisen as a byproduct of melodic goals, K's harmonic originality seems to have been intrinsically motivated; see, for example, K27, where K's A-flat produces an astringent minor ninth chord on the supertonic bass provided. A further measure of K's harmonic creativity can be gleaned from the number of ways in which she melodizes a given harmony within the ostinato pattern. For example, K overlays the second chord in the sequence (which in AO's original version comprises a simple D minor harmony—D, F, A) at different times in the course of her

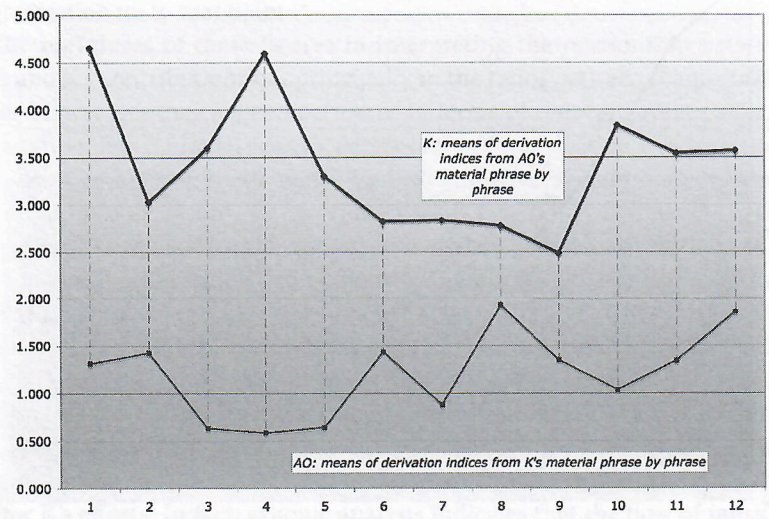


Figure 10.6 Indices of derivation and originality.

improvisation with D, F, G, A, B-flat, and C, using a range of melodic devices, described below.[20]

Despite the substantial impact of AO's improvisation on K's melody, the derivation is largely at a general level, whereby each feature almost invariably stems from a number of sources and the relationships concerned rarely have the salience to stand out from their coherence-creating neighbors and to acquire specific structural significance. There are exceptions, however, which function either through a series of relationships working in parallel or by prominent percepts being repeated in temporal apposition. For example, the syncopated rhythm first heard in the piano in measure 12 reappears in the vocal melody in measure 15—and then again in the piano in measure 24[21]—whereas from measure 30, K repeatedly derived A-flats and Fs from the accompaniment.

These findings reinforce the picture of K built up through the analysis of her improvised vocal line as an intuitive and unusually talented young musician but of one whose profile of musical development was uneven and idiosyncratic. Although she picked up very quickly on the ostinato AO provided—after only two iterations—and was able to improvise coherently and stylistically appropriately over its continuation, there was little if any direct emulation of the material provided, yet this is probably the most straightforward means of ensuring coherence in improvising with other musicians. Nor was there any direct borrowing from other pieces, although this technique is encountered widely in traditional jazz (see, e.g., Berliner 1994, 103 ff.).[22] Again, it seems reasonable to assert that this anomaly may partly be attributable to the contradictory impact of K's disability on her musicality, affecting it at once both positively and negatively.

Conclusion

In summary, an analysis was presented of a vocal melody that had been improvised against an ostinato piano accompaniment by a young girl with septo-optic dysplasia. The analysis employed a new music-theoretical technique rooted in cognitive science. The findings were used to gauge the impact of her disability on her musical development. Conclusions can be drawn in three main areas.

First, in relation to K's musical development, it is evident that within a familiar style she can grasp a repeating pattern of harmonies and create material that not only conforms to what is provided but that develops and extends it structurally and expressively. This shows exceptional musical development and reinforces the findings of previous research suggesting that congenital blindness may be a major contributory factor in such exceptionality. However, there is a lack of thematic correspondence between voice and accompaniment, certain common approaches to the logical connection of material are not used, and there is a concomitant absence of a deeper musical structure. These lacunae, it is argued, could well result from K's lack of music education, her early

years notwithstanding. Indeed, a key finding of Ockelford et al. (2006) is that early intervention is essential, particularly for children who show signs of exceptional musical ability. It is suggested that the self-same disability that engendered K's precocious development may also have elicited unduly low expectations of her musical potential and may have deterred those around her from seeking appropriate tuition. Hence, although K has evidently achieved a great deal by dint of her own efforts, it is also clear that much more remains to be done and that she would benefit from working with a teacher willing to engage with her musical interests and with the capacity to work flexibly in extending her musical horizons. Thus, through appropriate support the barriers that her disability may have erected in the minds of others would be removed, and her musicality could continue to develop untrammeled.

Second, although it has been asserted that K's improvisation is indicative of exceptional musical ability, no comparative data are currently available to indicate objectively just how typical or unusual her musical development is in relation to what one might reasonably expect from a child of her age, with or without a visual disability. This is an area that should be tackled as a matter of urgency: The approach adopted in this chapter may offer one way forward; see below. Meantime, this study offers direct musical evidence in support of the hypothesis that exceptional musical ability may well be unusually prevalent in young children with septo-optic dysplasia (Ockelford 2003; Pring and Ockelford 2005) and more widely among youngsters with little or no vision (Miller and Ockelford 2005; Ockelford et al. 2006; Ockelford, Welch, and Pring 2005)—irrespective of other disabilities they may have (Ockelford 1998). The analysis undertaken here also supports the notion that the essential elements of advanced musical understanding, many of which are typically conceptualized and codified in the process of music education, can develop and thrive at a purely intuitive level (Ockelford and Pring 2005, 2007).[23] Thus, one enduring message for researchers and teachers alike is the capacity of the mind to absorb and intuitively utilize sophisticated musical strategies with no formal tuition at all. However, a second and equally important point is that if children—particularly those with complex mixtures of ability and disability—are not to be left music-developmentally stranded, then timely and expert intervention is essential.

Third, it appears that the zygonic approach may be of value in interrogating certain aspects of the ebb and flow of musical interaction involving two performers or more. Although labor-intensive at this stage, key elements in this type of analysis could be automated, leaving the researcher to check and to refine the data gathered using an appropriate computer program. The techniques set out in this chapter could be used more widely to support the assessment of certain aspects of children's music-making, informing the aggregation of a bank of comparative data that would enable individual efforts to be contextualized. This would benefit music therapists and educators seeking to evaluate

the effect and effectiveness of their interactions with children with disabilities and other special needs. Indeed, the different and sometimes apparently conflicting aims of music teachers and therapists could be clarified and even resolved through adopting the common musical metalanguage that zygonic theory offers. Moreover, as music-analytical techniques such as those used here are further developed, it is interesting to postulate the extent to which the scrutiny of the purely musical elements of an improvisation with two people or more may shed light on aspects of broader personality and human relationships—including the capacity and willingness for imitation, resistance to change, and resilience—something of enormous potential value to both therapists and educators. Finally, and more broadly, the approach set out here may support the analysis of improvised forms in a range of genres, including jazz.

Notes

1. Septo-optic dysplasia is a rare condition that occurs in approximately 1 in 16,000 children. It is defined as a combination of optic nerve hypoplasia (i.e., absent or small optic nerves), pituitary abnormalities, and the absence of the septum pellucidum or corpus callosum—without which communication between areas of the mid-brain, such as the transfer of sensory information, is hampered. Among the likely effects of septo-optic dysplasia are visual impairment, hormonal problems, delayed development, behavioral difficulties, and obesity. The type and range of symptoms can vary from mild to very severe (Mehta and Dattani 2004). K is totally blind and does not have delayed development.
2. For comparison, Hamilton, Pascual-Leone, and Schlaug (2004) reported that 57 percent of blind musicians within a sample of twenty-one had AP.
3. At the time, I was working as a specialist music teacher in a school for visually impaired children in south London.
4. K was unaware of this or any other formal musical concepts or specialized terminology.
5. These names have been changed in the interest of preserving K's anonymity.
6. It is important to acknowledge that, in the case of K's song, words were present too, and although these are not the main focus of the discussion here, relevant points are noted in the context of the identified musical issues.
7. *Interperspective* is a term coined by Ockelford (1991) to mean between perspects—that is, perceived aspects—of music; it is used in contradistinction to the term *parameter*, which is reserved solely to refer to the physical attributes of sound. Hence, the perspect *pitch*, for example, most closely corresponds to the parameter *frequency*, though the connection between the two is far from straightforward (cf. Meyer 1967, 246).
8. For a discussion of interperspective relationships in the context of David Lewin's mathematically based theory of musical intervals and transformations, see Ockelford (2005a).
9. Observe that arrowheads may be open or filled—the former showing a link between single values and the latter indicating a compound connection within or between constants, typically values extended in time—implying a network of relationships that are the same. For a fuller explanation, see Ockelford (1999).
10. From the Greek term *zygon* meaning yoke, implying a union of two similar things.
11. Given the interdisciplinary nature of this chapter, it is particularly important to be clear about the status of zygonic relationships. They are hypothetical constructs intended to represent aspects of the typically subconscious cognitive processing that can be assumed to occur when we attend to, create, or imagine music—a supposition suggested by the structural regularities of pieces, which, as Bernstein (1976, 169) asserted, offer "a striking model of the human brain in action and as such, a model of how we think." Of course, the notion of a zygonic relationship can at best offer only a much-simplified version of certain cognitive events that may be stimulated by participation in musical activity. However, even though simplification is necessary to make headway in theoretical terms, it is important to bear in mind that the single concept of a zygon bequeaths a substantial perceptual

legacy with many possible manifestations not only potentially linking individual pitches, timbres, dynamics, durations, and inter-onset intervals but also prospectively existing between tonal regions, textures, processes, and forms that are the same; over different periods of perceived time; functioning reactively or proactively; and within the same and between different pieces, performances, and hearings. Given this variety, there is, of course, no suggestion that the one concept represents only a single aspect of cognitive processing. Hence, empirical evidence in support of the theory is likely to be drawn from a diversity of sources. Currently, for example, one can point to experiments in auditory processing, such as the continuity illusion summarized in Bregman (1990, 344 ff.) and work on expectation in a musical context, particularly that involving the perceptual restoration of omitted or obscured notes (for instance, DeWitt and Samuel 1990), to support the presence of proactive zygonic-type processes (Ockelford 1999, 123; 2006). General support exists for the theory too in the wide range of music-theoretical and analytical sources in which the fundamental importance of repetition in music is acknowledged. These are itemized in Ockelford (1999). Similar acknowledgments are made by Borthwick (1995) as a background to the exposition of his metatheoretical framework to which the notions of identity and nonidentity are central. Perhaps most pertinent of these to zygonic theory is Cone's (1987, 237) assertion made in relation to the derivation of musical material that "y is derived from x (y ← x), or, to use the active voice, x generates y (x → y), if y resembles x and y follows x. By 'resembles,' I mean 'sounds like.'"

12. That is not to say that to be coherent, K's improvisation should consist only of repetition. Through perceptual binding—the cognitive glue through which the different properties of an object cohere in the mind to form the notion of a single thing (see, e.g., Snyder 2000, 7)—and *Gestalt* perception—through which discrete events are reckoned to form larger wholes (see, e.g., Deutsch 1999)—sounds, or groups of sounds, may differ from each other in some respects while being the same in others. Hence, as is shown following, similarity and diversity work in parallel in the creation of musical material that is at once original and coherent.
13. Fuller presentations of data and their analysis are available in electronic form from the author.
14. As one mother of a twenty-three-year old in the 2006 septo-optic dysplasia survey stated, her son "could play the [piano and organ] well at four years old but never followed up, so lost a lot of his skills."
15. Hence, the analysis was as fine grained as it was practicable to make it. Longer pieces could be investigated using more substantial musical gestures as the primary unit of analysis.
16. This work was undertaken by AO, utilizing his intuitions as an experienced music analyst, performer, and educator. The principal disadvantage of this approach was the possibility of unconscious bias through idiosyncratic interpretation of the underlying structural relationships. The advantage was his intimate knowledge of the situation in question—in particular what was going through his mind as the accompanist. Future analyses along these lines could, though need not, be based more on the consensus of a number of people's views, depending on their purpose. Indeed, it is anticipated that a significant proportion of the analytical activity could be undertaken by computer through searching for combinations of similarity and salience through appropriate algorithms.
17. The number was chosen for pragmatic reasons—other analyses could involve more or fewer relationships per feature than this.
18. The ordering of these pitches is based on the grounds that, *ceteris paribus*, their temporal adjacency corresponds to their relative salience and therefore implicative strength. Factors that could impact on this assumption include the possibility of an event pertaining to a larger perceptual unit. Hence, it is thought that the bass note F at the beginning of measure 5, for example, more strongly derives from the bass notes at the beginning of measures 3 and 1, respectively, than the temporally more adjacent Fs in the vocal and piano melody lines—something reinforced through common and differing octaves, respectively.
19. The issue of material derived from other pieces is considered briefly in the third section of the analysis.
20. Similarly, although K's phrase lengths indicate her evident cognizance of the underlying harmonic structure, they are not bound by it, ranging in duration from two beats to nine.

Here the influence of the improvised words appears to have been particularly important. Moreover, in the manner of a mature musical dialogue, K sometimes left the piano to play on its own—notably in measures 11 and 12—partly to regroup her own thinking, no doubt, though nonetheless affording a convincing feeling of give and take.

21. The extent to which AO derives material from K—for example, in measures 28 and 35—is the subject of a separate investigation that seeks to gauge the balance of influence between the two parties and where the locus of control lies at any given point (Ockelford n.d.).
22. AO does borrow, however, quoting "Dream, Dream, Dream" by the Everly Brothers in measures 20–23.
23. K also shows us that, contrary to certain thinking, it is not necessary to know the names of notes to possess AP. For a discussion of a range of issues related to the current understanding of AP, see Deutsch, Henthorn, and Dolson (2004).