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Notes & Comment

On the Nature of Early Music Training and Absolute Pitch: A Reply to Brown, Sachs, Cammuso, and Folstein

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We discuss two issues raised in the article about the acquisition of absolute pitch published in *Music Perception* by W. A. Brown, H. Sachs, K. Cammuso, and S. E. Folstein (2002) with which we disagree. First, we describe that aspect of musical training we feel is relevant for the acquisition of absolute pitch. Second, we point out a disagreement about the statistical nature of developmental stages and critical periods. We describe an alternative view of absolute pitch acquisition.

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In their "Notes & Comment" appearing in *Music Perception 19*(4), "Early Music Training and Absolute Pitch," Brown, Sachs, Cammuso, and Folstein (2002) address the issue of whether the acquisition of absolute pitch (AP) is subject to critical period effects and hence requires early exposure in children who end up acquiring AP. The authors describe a study (Brown et al., 2003) in which 67% of AP possessors reported that they started music training at age 6 or younger. The authors argue that because there apparently exist some AP possessors (the remaining 33%) who did *not* have early training, it must therefore be the case that early training is not necessary.

We disagree with two principal points in their arguments. Based on our understanding of the literature, we believe that it is most probably not simply "music training" that leads to AP acquisition, but exposure to and reinforcement of the mapping between the sound of specific musical tones and their category labels (Cohen & Baird, 1990; Levitin, 1996, in press;

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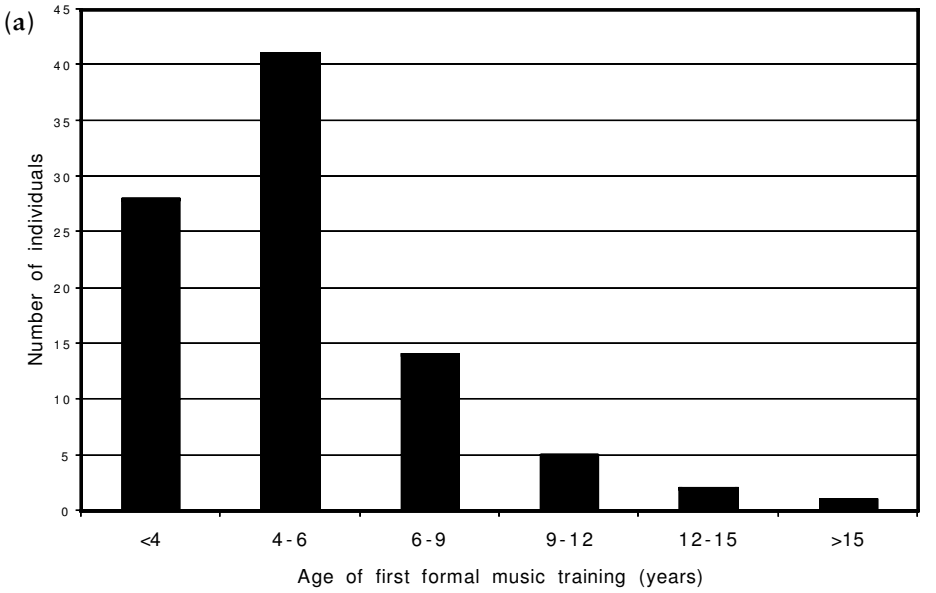
Parncutt & Levitin, 2001; Wedell, 1934; Zatorre, 2003). The acquisition of pitch categories may parallel that for color categories, for which the child must learn to distinguish one salient quality (pitch chroma) from a number of other perceptual attributes as a prerequisite to creating the correct mappings between tone (or color) and its linguistic label (Miller & Johnson-Laird, 1976, pp. 350–355; Levitin, 1996, in press). A notable difference between color naming and pitch naming, however, is that pitch naming among AP possessors is far more extensive, with as many as 50–70 discrete pitches being nameable across the continuum (Ward, 1999), whereas with color, absolute naming of hue is typically limited by Miller's (1956) memory limitation of seven plus or minus two.

Standard music training may actually *undo* any nascent AP ability, since it emphasizes relative pitch ability and musical interval perception rather than absolute tone identification (Abraham, 1901; Takeuchi & Hulse, 1993; Ward, 1999), although AP seems to develop sometimes despite such experiences. As with the acquisition of color categories, it stands to reason on logical grounds that what is required of the developing child who will become an AP possessor is to learn to make the association between particular auditory stimuli and their respective category labels. How and why these associations are formed in a relatively automatic way in AP possessors is so far unknown. But neuroimaging results indicate that those neural regions recruited in AP tasks are the same regions implicated in conditional associative learning—the application of labels to sensory percepts (Zatorre, Perry, Becket, Westbury, & Evans, 1998)—suggesting that these mechanisms are very specifically enabled for pitch in AP possessors.

A second point on which we disagree with Brown et al. (2002) concerns those few positive cases of apparent AP learning beyond the critical period. Critical periods—like other developmental stages including physical growth, onset of puberty, etc.—are not "brick walls" that define with absolute precision when something will occur. As with nearly every other biological and psychological process, they are distributed, often in a somewhat bell-curve or gamma-like fashion—that is, the critical period refers to a central tendency, an average age at which individuals pass through a particular developmental stage. The existence of a few outliers, as has been shown by Brown et al. (2002, 2003) and the scientific studies they cite (Gregersen, Kowalsky, Kohn, & West-Marvin, 1999; see also Gregersen, Kowalsky, Kohn, & West-Marvin, 2000), is consistent with the critical period hypothesis, and indeed is to be expected on purely statistical grounds and on the basis of the nature of developmental biological processes.

Baharloo, Johnston, Service, Gitschier, & Freimer (1998), for example, report the results of a survey that tracked age of onset of music training for 92 AP possessors. We have redrawn their original histogram here (Figure 1a) and used their data to fit a gamma distribution (Figure 1b). (Gamma



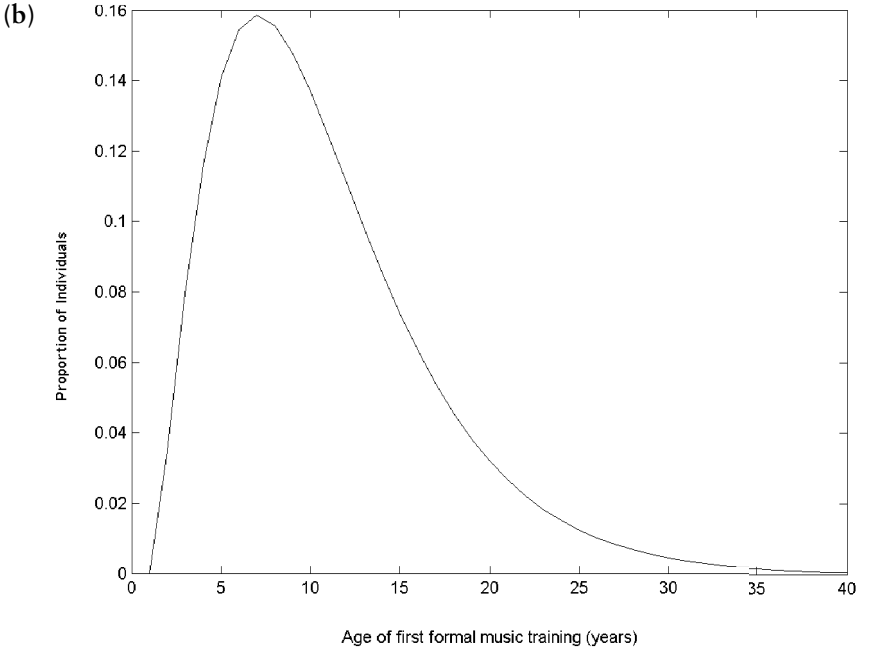


Fig. 1. (a) Age of first formal musical training (years) for 92 absolute pitch possessors. Data redrawn from Baharloo et al., 1998. (b) The same data as above, modeled by a gamma distribution with a shape parameter of 2.36 and a scale parameter of 2.11, as estimated by matching moments. Gamma functions are consistent with a number of developmental and biological processes in part because they are constrained asymmetrically at the zero point.

distributions are widely used to model a variety of psychological and biological processes; e.g., Casella, Wu, Wu, & Weidman, 2002; Levelt, 1967; Nei, Chakraborty & Fuerst, 1976; Restle & Davis, 1962). Notice that the distribution is characterized by a mode near 6 years old and the right tail of the distribution decreases monotonically to its asymptote. We would argue that the interesting scientific question concerns how to account for the shape and mode of this distribution; the search for one or several outliers is not of particular scientific interest, because such outliers are predictable and characteristic of most biological processes.

The fact is that a century of research has shown a significant negative correlation between age of onset of systematic tone-label mapping and the acquisition of AP (Takeuchi & Hulse, 1993). In addition, the authors themselves reveal an inherent flaw in the methods they have brought to bear on this issue—self-reports are not always reliable. As the authors themselves state, *all four* of their subjects who had initially reported late music training revised their estimates to an *earlier age of onset* under follow-up questioning.

Brown et al. (2002) write that "the notion . . . that music training during an early 'critical period' is sufficient for the development of AP appears untenable in light of . . . the fact that only a minority of people with early music training develop AP" and further that "it may be premature to conclude that early music training is necessary for expression of AP." With respect to the first point, we know of no source that claims that music training (or even training in tone-note associations) is *sufficient* for the development of AP—such a claim would be as misleading as claiming that training in a foreign language is sufficient for mastery of that language. Many people study foreign languages and never excel at them, of course, proving that training is not sufficient. Individual differences in motivation, ability, attention, and other cognitive factors certainly exist, as foreign language schoolteachers can attest. Finally, in this particular passage, Brown et al. (2002) seem to confound the ideas of "necessary" and "sufficient" conditions. Although we would not argue for the sufficiency of *any* type of training for the acquisition of AP, we would argue for its *necessity*—something the Brown et al. (2002, 2003) data cannot address, because they did not probe the type of tone-label mapping that we believe underlies the acquisition of AP.

Several reports have described improvement in pitch naming following certain training techniques (Cuddy, 1970; Heller & Auerbach, 1972; Lundin & Allen, 1962), but no documented case (in refereed journals) exists of an adult attaining true AP ability (Brady, 1970; Rush, 1989; Ward, 1999). The most well-known commercially available product (Burge, 1983) has not been shown to produce late acquisition AP possessors who are equivalent in skill to those who acquire AP early (Rush, 1989). Those who ac-

quire AP early show an effortlessness and automaticity not seen in those who acquire AP as adults. We hypothesize that one needs the combination of some as yet unknown substrate (perhaps genetic) in interaction with the right input at the right time. This is indeed the paradigm for many developmental milestone events, from ocular dominance columns in the cortex (Hubel & Wiesel, 1968; DeValois, Yund, & Hepler, 1982), to language grammar (Curtiss, 1977), and phonology (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992). We speculate that at the heart of these critical period effects are differences in neuroplasticity as a function of age, probably in interaction with a particular individual's genetic makeup and the environment. There is no reason to think that the acquisition of pitch labels (a skill with no obvious evolutionary basis) should be immune from the critical periods involved in a host of other neurodevelopmental events, and the nature of the statistical distribution that describes such critical periods renders uninteresting the mere presence of individuals at the tails of these distributions.

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