Musical Ability

Oliver Sacks, G. Schlaug, L. Jancke, Y. Huang, H. Steinmetz

Science, New Series, Volume 268, Issue 5211 (May 5, 1995), 621-622.

SCIENCE

Published by the **American Association for the Advancement of Science (AAAS),** *Science* serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objectives are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

Membership/Circulation
Director: Michael Spinella
Deputy Director: Marlene Zendell
Member Services: Rebecca Dickerson, *Manager*; Mary Curry, *Supervisor*; Pat Butler, Helen Williams, Laurie Baker, *Representatives*
Marketing: Dee Valencia, *Manager*; Jane Pennington, *Europe Manager*; Hilary Baar, *Associate*; Angela Mumeka, *Coordinator*
Research: Renuka Chander, *Manager*
Business and Finance: Jacquelyn Roberts, *Manager*; Robert Smariga, *Assistant Manager*
Administrative Assistant: Nina Araujo de Kobes
***Science* Member Services**
Marion, Ohio: 800-347-6969;
Washington, DC: 202-326-6417
Other AAAS Programs: 202-326-6400

Advertising and Finance
Associate Publisher: Beth Rosner
Advertising Sales Manager: Susan A. Meredith
Recruitment Advertising Manager: Janis Crowley
Business Manager: Deborah Rivera-Wienhold
Finance: Randy Yi, *Senior Analyst;* Shawn Williams, *Analyst*
Marketing: John Meyers, *Manager;* Allison Pritchard, *Associate*
Traffic Manager: Tina Turano
Recruitment: Terri Seiter, *Assistant Manager*; Pamela Sams, *Production Associate*; Debbie Cummings, Celeste Miller, Rachael Wilson, *Sales*; Charlotte Longhurst, *European Sales*
Reprints Manager: Corrine Harris
Permissions Manager: Lincoln Richman
Exhibits Coordinator: Arlene Ennis
Sales Associate: Carol Maddox

PRODUCT ADVERTISING SALES: East Coast/E. Canada: Richard Teeling, 201-904-9774, FAX 201-904-9701 • **Midwest/Southeast:** Elizabeth Mosko, 312-665-1150, FAX 312-665-2129 • **West Coast/W. Canada:** Neil Boylan, 415-673-9265, FAX 415-673-9267 • **UK, Scandinavia, France, Italy, Belgium, Netherlands:** Andrew Davies, (44) 1-457-838-519, FAX (44) 1-457-838-898 • **Germany/Switzerland/Austria:** Tracey Peers, (44) 1-270-760-108, FAX (44) 1-270-759-597 • **Japan:** Mashy Yoshikawa, (3) 3235-5961, FAX (3) 3235-5852
RECRUITMENT ADVERTISING SALES: US: 202-326-6555, FAX 202-682-0816 • **Europe:** Gordon Clark, (44) 1-81539-5211, FAX (44) 1223-302068 • **Australia/New Zealand:** Keith Sandell, (61) 02-922-2977, FAX (61) 02-922-1100
Send materials to *Science* Advertising, 1333 H Street, NW, Washington, DC 20005.

Information for Contributors appears on pages 112–114 of the 6 January 1995 issue. Editorial correspondence, including requests for permission to reprint and reprint orders, should be sent to 1333 H Street, NW, Washington, DC 20005.
Internet addresses: science_editors@aaas.org (for general editorial queries); science_letters@aaas.org (for letters to the editor); science_reviews@aaas.org (for returning manuscript reviews); membership@aaas.org (for member services); science_classifieds@aaas.org (for submitting classified advertisements)

LETTERS

Musical Ability

The report by Gottfried Schlaug *et al.* (3 Feb., p. 699) regarding the enlargement of the left planum temporale in professional musicians, and especially those with absolute pitch, provokes many thoughts.

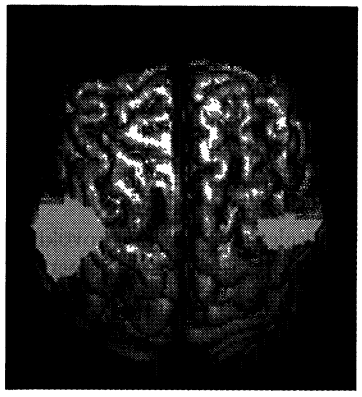
Absolute pitch, while extremely rare in the general population [its incidence has been estimated as 1 in 10,000 (*1*)], is relatively common among professional musicians, and to a limited extent [as is also suggested by Schlaug *et al.*'s magnetic resonance images (MRIs)] may serve as a marker for musicality. But as N. Slonimsky, in his autobiography, *Perfect Pitch*, writes (*2*)

> the lack of it does not exclude musical talent, or even genius. Neither Wagner nor Tchaikovsky had absolute pitch, while a legion of mediocre composers possessed it to the highest degree.

There is a greatly heightened occurrence of absolute pitch in some other populations: among the autistic the incidence may be about one in 20; and among those with savant syndrome, more than a third have musical gifts—and all musical savants, apparently, have absolute pitch (*3*).

A comparable incidence seems to exist among individuals with Williams syndrome—a syndrome which predisposes to hyperacusis and exceptional development of auditory, musical, and verbal skills, combined with striking visual and conceptual deficits. Current neuromorphological studies show a relative enlargement of primary auditory cortex (Heschl's gyrus, A1) in subjects with Williams syndrome (*4*). It would be worthwhile to extend high-resolution magnetic resonance morphometry to studying the planum temporale in these special, musically gifted but disabled populations.

The extremely precocious appearance of absolute pitch, which tends to manifest itself full-blown before the age of five, its relative isolation from conceptual, verbal, or even general musical powers (it may indeed interfere with musical enjoyment and performance), and its remarkable incidence in individuals with neurodevelopmental disorders such as Williams syndrome and autism all suggest that it is a "savant" talent. Savant talents, in their functional isolation, their autonomy, and their independence of training or practice, seem to be rather different in character from "normal" talents. It has been hypothesized by Lynn Waterhouse (*5*) and others that such talents may be dependent on the development of a specialized focal neural network or "neuromodule." One must wonder whether the presence of such a neuromodule is being demonstrated in the MRIs done by Schlaug *et al.*



GOTTFRIED SCHLAUG

Brain Teaser. Is larger planum temporale (red) on left side of brain in musicians with perfect pitch a key to other brain disorders?

Oliver Sacks
Institute for Music and Neurologic Function, Beth Abraham Hospital, Bronx, NY 10461, USA

References

1. A. Bachem, *J. Acoust. Soc. Am.* **27**, 1100 (1955).
2. N. Slonimsky, *Perfect Pitch* (Oxford Univ. Press, New York, 1988).
3. B. Rimland and D. Fein, *The Exceptional Brain: Neuropsychology of Talent and Special Abilities*, L. K. Obler and D. Fein, Eds. (Guilford, New York, 1988), pp. 474–492; D. Treffert, *Extraordinary People: Understanding "Idiot Savants"* (Harper & Row, New York, 1989).
4. G. Hickok *et al.*, paper presented at the 1995 meeting of the Cognitive Neuroscience Society, San Francisco, CA, 26 to 28 March 1995.
5. L. Waterhouse, *The Exceptional Brain: Neuropsychology of Talent and Special Abilities*, L. K. Obler and D. Fein, Eds. (Guilford, New York, 1988), pp. 493–512.

Response: Sacks argues that the exaggerated leftward asymmetry of the planum temporale found in musicians with perfect pitch may also underlie perfect pitch as a "savant talent" in disabled persons. Although his comments are speculative, they may help to form new concepts for a neurobiology of special talents, in particular because planum temporale asymmetry in humans has been shown to reflect asymmetrical development of nonprimary auditory cortices (*1*).

In spite of the fact that Sacks's suggestions are germane to our work, we are somewhat reluctant to compare savant subjects with gifted musicians. In contrast to sa-

vants, the subjects included in our study exhibited average or above average intelligence and exceptional musical skills, with no apparent deficits in other cognitive functions. Furthermore, our subjects did not exhibit either of the two poles of aberrant social behavior, such as the extreme sociability of Williams syndrome patients or the withdrawal of autistic savants. Also, savants are more compulsive in pursuing their special abilities than are normal musicians. Thus, savants demonstrate patterns of psychosocial functions that are different from those of the musicians we studied, making a comparison difficult.

Nevertheless, a thought-provoking hypothesis implicit in Sacks's comment would be that special talents may be a result of the asymmetrical development of specialized "neuromodules." This hypothesis, which is compatible with our study and with the work of others (*2*), is intriguing and testable, at least in the case of perfect pitch.

G. Schlaug
Department of Neurology,
Beth Israel Hospital, Dana 779,
330 Brookline Avenue,
Boston, MA 02215, USA
L. Jäncke
Y. Huang
H. Steinmetz
Department of Neurology and
Institute of General Psychology,
Heinrich-Heine University,
40001 Düsseldorf, Germany

References

1. C. von Economo and L. Horn, *Z. Neurol. Psychiatr.* **130**, 678 (1930); A. M. Galaburda, F. Sanides, N. Geschwind, *Arch. Neurol.* **35**, 812 (1978).
2. I. Q. Whishaw, *Behav. Brain Sci.* **52**, 45 (1992); J. L. Ringo, R. W. Doty, S. Demeter, P. Y. Simard, *Cereb. Cortex* **4**, 331 (1994).

■

World Wide Web and Molecular Biology

Bruce R. Schatz and Joseph B. Hardin (Articles, 12 Aug. 1994, p. 895) write, "The revolution of the Net is just beginning." This may be so, but of critical importance to many researchers—especially biologists—is the fact that the Net, and the World Wide Web (WWW) set of protocols in particular, are of immense utility *now*. For example, every molecular biologist could make fruitful use of the WWW GenBank/Entrez (*1*). A collection of nearly all biosciences WWW information servers is maintained by Keith Robison at Harvard (*2*).

At a most fundamental level, these network resources are equivalent to storing current databases locally, but without consuming resources. In addition, most facilities provide additional features; for example, WWW Entrez includes links to images and coordinates of proteins whose structures have been solved. A single Web viewer can provide a simple interface that embodies many of the complex features of sophisticated database access and analysis systems. Moreover, the WWW is indeed worldwide and encourages links between databases. The paragon of this connectivity is the Sequence Retrieval System (SRS) (*3*), which interlinks some two dozen databases. It has, in essence, merged many of the major biological databases of the world into one comprehensive structure.

Another major feature of the WWW is the ease with which complex, hierarchical data structures can be made accessible and intelligible. The ability to separate different levels of information has caused the network version of FlyBase (*4*) to virtually supplant the Red Book (*5*). Similarly, a number of model organism databases using ACEDB (*6*) have been made available on the WWW (*7*). Although WWW implementations currently lack ACEDB's powerful visualization tools (for example, for viewing and modifying sequences), stan-