## The sound-localization ability of cats

To the Editor: The paper by Tollin and colleagues in the March 2005 issue of the Journal of Neurophysiology describes the sound-localization ability of cats trained to orient their eyes to the source of a sound (Tollin et al. 2005). The main finding of this paper, which was the subject of an Editorial Focus (Sparks 2005), was that cats are extremely accurate in directing their eyes to the source of a sound when their heads are unrestrained. For example, Tollin and colleagues state that cats

a sensory system (or any measurement device for that matter) is related to its accuracy. In this letter we show that precision of localization is more likely related to acuity. We should first make clear what is meant by these terms.*Accuracy* describes the closeness of a measurement to the true value, whereas *precision* describes the consistency of the measurement or the degree to which several measurements provide similar answers.

Behavioral studies of sound localization generally use one of two psychophysical procedures.*Relative* procedures assess the acuity or spatial-resolving power of the localization system by measuring the minimum audible angle (MAA; Mills 1958), the smallest angle separating two sources that can be discriminated.*Absolute* procedures measure the actual ability to indicate the sound source location, which is quantified in terms of accuracy and precision. Although both methods purport to measure something about localization capabilities, it is, in fact, unknown how or even whether measures of acuity such as the MAA are related to measures of localization accuracy and precision. Despite this uncertainty, it is often believed that acuity can be informative of accuracy (e.g., small MAAs predict accurate localization; large MAAs predict poor accuracy).

To be fair, the misconception is a reasonable one because in daily usage the terms *accuracy*, *precision*, and—at least in psychophysics—*acuity* are often used interchangeably. However, two simple thought experiments show that acuity and accuracy need not be related at all, but rather that acuity is likely related to localization precision. First, suppose 100 darts are thrown at a dartboard, a process analogous to a cat localizing auditory targets by gaze shifts. Figure A1 shows four possible scenarios. (1) The bull's-eye is hit virtually every time (top left). This means that the throws were both accurate [that is, the average location was close to the target (bull's-eye)] and precise (that is, the location of the throws was consistent and reproducible regardless of accuracy). (2) The throws had the exact same consistency as before, but each throw misses to the left (top right). These throws were not accurate because, on average, the bull's-eye was missed, but were still precise because the throws were highly reproducible. (3) Sometimes dart throws scored a direct hit within the bull's-eye, but the rest were scattered evenly around the board (bottom left). (4) [(shrows)-uditose bthe

were thrown at each of two different targets, in turn, that were separated in azimuth. The example on top shows throws that are accurate but not precise. With respect to sound localization, letÕs suppose that the location of each dart throw was an exact