

Noise Exposure of Music Teachers:

Approximating Noise Exposure in small-group woodwind lessons

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About this document

- **This is a 2023 pdf version of an older web page**, part of a longer series.
- Neither content nor links have been updated. Links may not work.
- Please visit malcolmtattersall.com.au/music/noise-exposure-of-music-teachers/ for an introduction to the whole series.

Associated documents

- *Noise Exposure of Music Teachers: Introduction*
- *Defining the Problem*
- *Teaching Strategies to reduce noise exposure*
- *Approximating Noise Exposure in small-group woodwind teaching*
- *Hearing Loss, Noise Exposure and the Law*
- *Hearing Protection for music teachers*
- *Links*

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Please refer to the introductory page for important information about this article.

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Noise exposure is expressed in terms of the level of an equivalent steady sound which would cause as much damage to the ears at the actual sound. The abbreviation for this measure is Leq and it can be defined over any chosen period or activity. Leq of a steady sound is equal to the loudness in dB of that sound, but Leq of a concert or a day at the races is a sort of average, below the loudest sound but above the quietest.

Several factors affect the average noise level experienced in a small-group instrumental lesson. Here I will discuss teaching style, group size and instrument types, and room acoustics. Their effects can be estimated fairly accurately and combined to produce close approximations of actual situations.

Teaching style (1)

In a music lesson, there is talking as well as playing. The effect is to reduce Leq of the lesson by an amount that depends on the ratio of talking to playing.

If we have the teacher with one or more woodwind students (up to four, and all playing the same kind of instrument, for the sake of simplicity), the noise sources and their levels at any one time will typically be:

Background noise	50 dB
Student talking	60
Teacher talking	65
One person, either student or teacher, playing	80 (e.g. flute)
2 - 4 of the people playing (by 3 dB rule)	83 - 86

The minimum sound level if even one instrument is playing is at least 10 dB above conversation levels. That means the talking contributes virtually nothing (less than 0.5 dB) to the Leq, so the noise exposure in the lesson is effectively the exposure due to the playing time.

The proportion of playing to verbal instruction or discussion will obviously vary according to teaching style, the subject of the lesson (e.g. new concepts introduced), and the age and maturity of the students. My feeling as a teacher in this situation for twenty years is that the ratio of playing to talking is typically 60:40, with a range between 80:20 and 40:60. The ratio can't go much higher because each lesson (1) starts with greetings and the routine of getting out instruments, setting up music stands and finding music, (2) ends with the reverse sequence and (3) contains some instructional component. Equally, it won't go much lower or the students will feel cheated and the teacher will not even discover what they have achieved since the last lesson.

It is possible to measure the ratio with reasonable accuracy by recording a lesson then editing out predominantly-quiet sections of more than about ten seconds (easily and quickly done by eye with audio editing software such as 'Sound Studio'). I have done so for three lessons given by myself and another teacher. The ratios were 60:40 (one teacher), 55:45 and 80:20 (the other).

But if the ratio of playing:talking varies by 2:1, Leq of the lesson has a range due to that variation of just 3 dB. And if the maximum playing time is 80% of the lesson time, the upper limit of that range is about 1 dB lower than the typical performance level, so **Leq of the lesson will be between 1 and 4 dB less than the Leq of continuous playing.**

Number of students in a lesson

The 3 dB rule gives us a good approximation of changes in instantaneous sound levels with group size but Leq of the lesson is not simply proportional to the instantaneous level.

For each additional student, we should expect to see increases in the set-up and pack-up time, the general conversation, the tuning (one player at a time), the time it takes to assess individual playing (e.g. to see whether an articulation is applied), and the amount of sectional playing (e.g. the teacher will listen to half the group play a passage, then the other half, then all together). Since the lesson length has not increased, the percentage of time when the whole group plays together must be smaller.

We might also expect that students may play more quietly if a large group in a small teaching space begins to get too loud for comfort. Additionally, the teacher may be more likely to play

more often with smaller groups, either to do more demonstrating in the absence of a competent student or to make an ensemble item playable by filling in a missing part.

All these effects will tend to reduce, though not eliminate, changes in noise exposure due to changes in group size; instead of a 3 dB change for doubling or halving the number of players, 2 dB seems more likely.

If students in a larger group play individually or in sub-groups, as they sometimes will, Leq of the lesson must drop; but even if the students never play together, Leq will not go below the Leq of a lesson for one student. The upper end of the range for a single student might be considered a reasonable lower limit for the Leq of any larger group.

Dynamic range

We have been talking in terms of a single sound level, but of course musical instruments need to be able to play louder and softer. For instance, Meyer (see [Links](#) page, which will open in a new window) gives dynamic ranges for flute, clarinet and trumpet of 25, 40 and 25 dB respectively (these are the differences between loud and soft of one instrument, not absolute values of loud or soft).

Since we have spoken in terms of Leq all the way, the actual dynamic range of any instrument is irrelevant to the Leq of the lesson except that different players will play at different levels within its range. It is possible, though, to estimate the Leq of an instrument in performance from its dynamic range. Consider:

1. Most instruments spend most of their time in the middle of their dynamic range - *mp* to *mf* - with excursions above it for emphasis and below it for contrast. These will tend to average out. Further, beginners tend to have narrower dynamic ranges than advanced players.
2. The sound is not continuous, because it is interrupted by breathing and articulation. These gaps reduce Leq of the performance in just the same way as talking during the lesson reduces Leq of the lesson, though if a sound:silence ratio as low as 40:60 reduces Leq by only 4 dB, the effect is going to be small.

So Leq of an instrument in performance will be a little below the middle of the instrument's dynamic range.

Now let's look at actual levels

Here are some sample levels for individual primary students and small groups, with some long-tone values from individual players for comparison. All were measured at teaching distance (1.5 - 2.5 metres) in typical teaching spaces (approx 4 x 5 m, 2.4 m ceiling height) with a RadioShack SPL meter set on slow response and A weighting:

Year level	Instrument types (Flute, Clarinet, Alto Sax) and numbers	Performance levels dB
5	Beginner F	76 - 80
5	Beginner FFF	77 - 87

5	Advanced beginner FF*	78 - 86
6 - 7	Intermediate FFFF	78 - 86
5	Beginner FFFF	82 - 86
5	Beginner CC	74 - 82
6 - 7	Intermediate CC	75 - 83
6 - 7	Intermediate CC (upper register) F	76 - 90
5	Advanced beginner CCCC	85 - 92
5	Beginner SS	86 - 96
5 - 7	Intermediate SSCC	84 - 92
Adult	F legato melody at <i>mf</i>	78 - 82
Adult	C legato melody at <i>mf</i>	78 - 86
Summary	1 to 4 beginner F and/or C	74 - 86 (mid-range: 80)
	2 to 4 intermediate F and/or C	78 - 90 (mid-range: 84)
	Any 2 to 4 students including S	84 - 96 (mid-range: 90)
Year level	Instruments (Flute, Clarinet, Sax)	Sustained levels dB
5	Advanced beginner S (at her max. volume, long tone)	92

Adult	F, low register long tones <i>pp</i> - <i>ff</i>	60 - 84 (mid-range: 72)
Adult	F, middle register long tones <i>pp</i> - <i>ff</i>	72 - 92 (mid-range: 82)
Adult	F, top register long tones <i>pp</i> - <i>ff</i>	84 - 94 (mid-range: 89)
Adult	C, low register long tones <i>pp</i> - <i>ff</i>	54 - 92 (mid-range: 75)
Adult	C, throat register long tones <i>pp</i> - <i>ff</i>	64 - 90 (mid-range: 77)
Adult	C, upper register long tones <i>pp</i> - <i>ff</i>	82 - 98 (mid-range: 88)

* 'advanced beginners' have been playing nearly a year, 'intermediate' students up to three years. The adults are competent but not professional-level players.

Saxophone is the loudest woodwind and even a first year player can produce 92 dB. Very early beginners (first few months) tend to be very quiet on flute, about the same as more advanced players on clarinet, and uncontrollably loud on sax.

It is apparent that if there are different instrument types in the one lesson (e.g. clarinet and sax), the quieter instruments have little effect on the combined level: the level of two saxophones is the same as the level of two saxophones and two clarinets, within the limits of our accuracy.

Typical Leq for flutes and beginner clarinets in performance appears to be around 80 dB, with intermediate clarinets 2 - 4 dB higher and saxophones about 10 dB higher.

Teaching style (2)

Almost all this discussion has assumed the teacher does not play at all during the lesson. **If the teacher does play**, that must increase his or her noise exposure. (Even if the teacher's playing just replaces some student playing, the teacher's own instrument is closer to his or her ears and exposure will be greater rather than less.)

The percentage increase, though, should not be great, since the difference in level between five people playing and four is only about 1 dB if all else is equal. Even allowing for a mature player's bigger sound and the distance effect, the effect over the span of the lesson is still unlikely to reach 5 dB.

Room acoustics

The above discussion assumes the teaching space is adequate without being unusually reflective

(e.g. cement brick walls, hardboard ceiling and tiled floor) or absorptive (acoustic-tiled ceiling, baffled walls and carpeted floor), or much larger than is necessary to accommodate the teacher and students.

According to Eaton (see [Links](#)), changes in these factors can alter Leq by 2 or 3 dB. Royer (see [Links](#)), discussing band room size (p.151), found that room volume per student was significant and followed Geerdes (1989) in recommending 600 - 700 cubic feet (18 - 21 cubic metres) per student as desirable and 400 cubic feet (12 cubic metres) as the minimum acceptable. Further investigation is desirable but for now the effects seem small enough to be non-critical.

Conclusions

Leq of small-group woodwind lessons must typically lie between 75 and 90 dB, with most of the variation due to the instrument type and number (in that order), from one beginner flute or clarinet up to four mature sax players. The upper end of the range is rarely going to be reached, since it represents a large group of saxophones playing together nearly all lesson. Similarly, the lower end of the range represents just one or two beginner flutes or clarinets playing less than usual in a lesson.

The typical Leq for a lesson with two to four flutes and/or clarinets therefore seems likely to be in the low 80's. Larger groups (up to eight students) or any group with saxophones will be louder, i.e. into the high 80's. The impact of teaching style and room acoustics on Leq is smaller but may be significant.

Notes

See [Links](#) page for details of all references.