VIBRATION TIME AND REST TIME DURING SINUSOIDAL VIBRATION EXPERIMENTS: DO THESE FACTORS AFFECT COMFORT RATINGS?

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Introduction

Industrial exposure to whole-body vibration is associated with injury and discomfort. Certain industries, notably mining, construction, and forestry, involve complex 6 degrees of freedom vibration. Laboratory-based studies of vibration are essential for controlled and systematic evaluation of the human responses to vibration². The purpose of this pilot study was to evaluate whether the duration of the vibration exposure, and rest between vibrations, significantly influence the subjective ratings of comfort during laboratory-based studies of vibration.

Methods

Subjects: The cumulative vibration dose was calculated, and was below the health guidance caution zone recommended by International standards³. The experimental procedures were approved by the University of Guelph Research Ethics Board. Ten adult subjects participated in this pilot experiment. All subjects completed the entire experimental paradigm; no subjects complained of pain during or after the experiment.

Experimental Design: The experiment consisted of four blocks of vibration exposures; either 15 or 20 seconds of vibration (1 df:Z axis, 3 df:XY plane, 3df:YZ plane, or 6 df) alternating with either 5 or 10 seconds rest. The order of presentation of the four blocks was randomized. Each of the blocks was composed of 37 individual sinusoidal vibration exposures in randomized sequence. This abstract focused on ten identical trials, (6.3 Hz vertical vibration, 0.55 m/s² RMS) interspersed within each block, in order to assess whether the subjects' comfort ratings systematically varied between the 15 or 20 vibration exposures, the 5 or 10 second rest between vibrations, or within each block. The experiment involved 43 minutes of vibration within the 62 minute experiment.

Vibration Apparatus: A commercial parallel robotic platform was used to apply the specific vibration exposures (R2000, Parallel Robotics Systems Corporation, Hampton, New Hampshire). The subjects sat on a passenger seat from a 1992 Honda Accord that was rigidly mounted to the robotic platform (Figure 1). This robotic system performed the specific vibration exposures operating under closed-loop displacement control. A custom-written Matlab program automated the testing sequence.

Comfort Measures: Subjective feelings of comfort were verbally reported following each vibration exposure (during the rest period). The comfort scale was modelled after a previously published 9 point continuous comfort scale¹ which provided the greatest reliability and discrimination between different vibration intensities among 14 scales, but was modified to enable verbal reports (0 = "zero discomfort" & 8 = "max. discomfort").

Statistical Analysis: The raw comfort scale values for the ten identical vibration trials in each of the four blocks were analyzed using a three-way ANOVA.

Results

Figure 2 illustrates each of the subjects' comfort ratings for the ten repeated trials, collapsed across blocks of vibration duration. Statistical analysis did not observe significant interactions or main effects.



Discussion

We did not observe statistically significant differences in comfort between the 15 or 20 second vibration exposures, or the 5 vs10 second rest durations. In addition, the comfort ratings did not vary systematically within the blocks of vibration. It appears that the one hour experiment duration did not result in systematic changes in reported comfort. This information is helpful for designing future laboratory-based vibration experiments.

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Index of Authors

Agresti, M.	57
Aldien, Y.	40
Alzate, M.	74
Amirouche, F.	29, 38
Ando, H.	70
Ankrum, J.	64
Bain, J.	61, 154
Bedard, S.	74
Belanger, C.	74
Bhambhani, Y.N.	72
Boileau, PÉ.	14, 40, 91, 95, 114, 119,
	168
Boninger, M.L.	134
Boutin, J.	14, 114
Brammer, A.J.	20, 51
Brodersen, T.	124
Burdisso, R.	112
Cann, A.	83
Chang, WR.	85
Chen, JC.	85
Cherniack, M.G.	20, 51
Choi, SH.	87
Christ, E.	150
Christiani, D.C.	85
Contratto, M.	66, 124, 130, 132
Cooper, R.A.	134
Cooperrider, N.K.	77
Curry, B.	61, 158
Dale, A.M.	22, 106
Deeb, T.	12
Demont, R.	93
Dickey, J.	168
Dong, C.L.	142
Dong, R.	1, 16, 27, 42, 97, 101, 140,
	142
Dun, S.	162
Eger, T.	14, 83, 119, 168
Estrada, N.	146
Evenoff, B.	22, 106
Fischer, S.	150
Frey-Law, L.	66, 130, 132
Galaviz, P.	57
Gibbons, J.D.	48
Gibson, R.G.	48
Gillin, E.K.	83
Gordon, J.J.	77
Gores, B.	150
Govindaraju, S.	61, 154
Grenier, S.	119
Griffin, M.J.	2, 3, 33
Grosland, N.	66, 130, 132

Guttenberg R	148
Harrer K	146
Hatfield B H	85
Havden C	16
Hinton G	138
Hong S I	27
Horova N	126
Howard I	130
Hunsted T	122
Hunt M	132
пипі, M. Ishitalıa Т	85
Isilitake, I.	/0
Jallg, HK.	0/
Jennings, C.	140
Jetzer, I.	53, 152
Jobes, C.	29
Johanning, E.	150
Johnson, C.	156, 158
Johnson, M.	112
Johnson, P.W.	90
Jorgensen, M.J.	164
Joshi, A.	152
Kadam, R.	112
Kaulbars, U.	117
Keller, T.	99
Ketcham, D.	53, 152
Khan, K.	164
Khanal, S.	123, 140
Kim, J.	16
Kittusamy, N.K.	29, 126
Kopp, G.	66, 130, 132
Krajnak, K.M.	1, 42, 59, 101, 156, 158,
	160
Larson, R.	123
Lavery, C.	146
Leblanc, G.	114
Lee, J.	68
Lee Shee, N.	168
Leonard, S.S.	160
Leu, M.C.	152
Li, L.	35
Li, ZM.	162
Lifchez, S.	57
Liu, Q.	14
Luhrman, R.	150
Lundstrom, R.	51
Ma, S.	91
Maeda, S.	2, 5, 31, 99, 136
Maikala, R.V.	72
Mandapuram, S.	91
Mansfield, N.	2, 5, 18
Marcotte, P.	40, 114

Marshall, D.	124
Martin, B.J.	25, 68
Matloub, H.S.	55, 57
Mayton, A.	29, 38
Merchant-Hanson, J.	57
Meyer, J.D.	51
McCormick, R.	97
McDowell, T.W.	27, 142
Miller, G.R.	156, 160
Morioka, M.	33
Morse, T.F.	51
Mosher, S.E.	144
Mullinix, L.	123, 138
Murray, S.L.	148
Nakashima, Y.	31
Natani, A.	95
Neal, K.	123
Neely, G.	51
Nelisse, H.	95
Nelson, C.	2,9
Nilsson, T.	51
Nowell, J.	146
Oddo, R.	114
Oeullette, S.	114
Oliver, M.	168
Pankoke, S.	46
Patra, S.K.	95
Persson, M.	110
Peterson, D.R.	20, 51
Pierce, J.	121
Ploger, J.	90
Polsani, A.	164
Pronesh, A.	93
Raasch, C.	121
Rahmatalla, S.	66, 130, 132
Rakheja, S.	25, 40, 91, 93, 95
Reynolds, D.	12, 79
Rider, K.A.	25, 68
Riley, D.A.	55, 57, 61, 154
Rowe, D.	57
Sakakibara, H.	2,7
Salmoni, A.	83
Sanger, J.R.	55, 57
Satou, Y.	70
Schwartz, K.	112
Siefert, A.	44
Skogsberg, L.	108
Smets, M.	14, 119
Smith, J.A.	104
Smith, S.D.	104, 144
Song, CM.	87
Song, W. J.	16
Spratt, K.	64

Standeven, J.	22, 106
Stayner, R.	81
Stevenson, J.	119
Tessier, B.	74
Tillim, S.	166
Toppila, E.	51
Trick, L.	168
Turcot, A.	74
Valero, B.	38
Vi, P.	83
Warren, C.	142
Warren, N.	51
Wasserman, D.	123, 138
Wasserman, J.	123, 138
Waugh, S.	156, 160
Welcome, D.E.	16, 27, 40, 97, 101, 140,
	142
Wiker, S.F.	27
Wilder, D.	64, 66, 130, 132
Wilson, S.	35
Wirth, O.	1, 156
Wolf, E.J.	134
,	151
Wolfel, H.P.	44
Wolfel, H.P. Wu, J.	44 1, 42, 142
Wolfel, H.P. Wu, J. Xia, T.	<u>44</u> <u>1, 42, 142</u> <u>64, 66, 130, 132</u>
Wolfel, H.P. Wu, J. Xia, T. Yan, J-G	44 1, 42, 142 64, 66, 130, 132 55, 57
Wolfel, H.P. Wu, J. Xia, T. Yan, J-G Yan, Y.	44 1, 42, 142 64, 66, 130, 132 55, 57 57
Wolfel, H.P. Wu, J. Xia, T. Yan, J-G Yan, Y. Yniquez, D.	44 1, 42, 142 64, 66, 130, 132 55, 57 57 146
Wolfel, H.P. Wu, J. Xia, T. Yan, J-G Yan, Y. Yniquez, D. Yoon, JH.	44 1, 42, 142 64, 66, 130, 132 55, 57 57 146 68