

Supplementary Material



Figure S1. VR controllers examined.

Table S1. Test design rotary control.

Run	A:Angular resolution [°/s]	B:Diameter [mm]	C:Inclination [°]	D:Haptic feedback	E:Acoustic feedback	F:Hand visualization	G:Shape	H:Position of the subject	J:Input device	K:VR environment
1	10	40	45	No	No	No	Knurling	Sitting	Valve Index	Crane
2	45	110	0	No	Yes	No	Cylinder	Sitting	Valve Index	Crane
3	45	40	45	Yes	No	No	Knob	Standing	Valve Index	Crane
4	45	40	0	No	Yes	Yes	Knurling	Standing	HTC Vive	Table
5	10	80	0	Yes	No	Yes	Cylinder	Standing	Valve Index	Table
6	21	40	0	No	No	Yes	Cylinder	Standing	HTC Vive	Crane
7	10	110	45	No	No	No	Knurling	Sitting	Valve Index	Table
8	17	110	90	Yes	Yes	Yes	Knurling	Standing	Valve Index	Crane
9	41	110	45	Yes	No	No	Knurling	Sitting	HTC Vive	Table
10	17	110	90	Yes	Yes	Yes	Knurling	Standing	Valve Index	Crane
11	10	40	0	Yes	Yes	Yes	Knob	Sitting	HTC Vive	Table
12	45	40	45	Yes	No	No	Knob	Standing	Valve Index	Crane
13	14	40	90	Yes	No	Yes	Knob	Standing	Valve Index	Table
14	45	80	90	No	No	Yes	Knob	Sitting	Valve Index	Table
15	41	110	45	Yes	No	No	Knurling	Sitting	HTC Vive	Table
16	45	110	90	Yes	Yes	No	Cylinder	Standing	Valve Index	Table
17	45	80	90	No	No	Yes	Knob	Sitting	Valve Index	Table
18	10	80	90	No	Yes	No	Cylinder	Standing	HTC Vive	Table
19	10	80	90	No	Yes	No	Cylinder	Standing	HTC Vive	Table
20	45	40	90	Yes	No	Yes	Cylinder	Sitting	HTC Vive	Crane
21	23	80	45	Yes	Yes	No	Knob	Sitting	Valve Index	Crane
22	10	110	0	No	No	Yes	Knob	Standing	HTC Vive	Crane
23	20	80	45	Yes	No	Yes	Cylinder	Sitting	Valve Index	Crane
24	20	40	0	No	No	No	Knob	Standing	Valve Index	Table
25	20	80	0	Yes	Yes	Yes	Knob	Sitting	HTC Vive	Crane
26	20	20	90	Yes	Yes	No	Cylinder	Sitting	HTC Vive	Crane
27	20	80	0	Yes	No	No	Knurling	Standing	HTC Vive	Table
28	5	80	90	Yes	No	Yes	Knurling	Sitting	HTC Vive	Crane
29	20	40	0	Yes	No	Yes	Cylinder	Sitting	Valve Index	Table
30	20	20	0	No	Yes	Yes	Knurling	Standing	Valve Index	Table
31	5	20	90	No	Yes	Yes	Cylinder	Standing	HTC Vive	Crane
32	20	80	0	No	No	No	Knob	Standing	HTC Vive	Crane

Table S2. Test design joystick.

Run	A:Max. positioning speed [%/s]	B:Max. Angle of deflection [°]	C:Size [mm]	D:Position of the subject	E:Shape	F:VR environment	G:Angular resolution	H:Input device	J:Haptic feedback	K:Acoustic feedback	L:Visual feedback	M:Hand visualization
1	2.5	10	15 / 7 cm	Sitting	vertical	Table	3-stage	HTC Vive	Yes	No	No	Yes
2	10	10	15 / 7 cm	Sitting	horizontal	Crane	5-stage	HTC Vive	Yes	No	No	No
3	10	30	24 / 11 cm	Standing	horizontal	Table	5-stage	Valve Index	Yes	No	No	Yes
4	10	30	32 / 15 cm	Standing	horizontal	Crane	3-stage	HTC Vive	No	No	Yes	Yes
5	2.5	30	15 / 7 cm	Standing	horizontal	Crane	linear	Valve Index	Yes	Yes	Yes	Yes
6	2.5	45	15 / 7 cm	Sitting	vertical	Crane	3-stage	HTC Vive	No	Yes	Yes	Yes
7	2.5	30	15 / 7 cm	Standing	vertical	Table	linear	HTC Vive	No	No	No	No
8	10	30	15 / 7 cm	Standing	vertical	Table	3-stage	Valve Index	Yes	Yes	Yes	No
9	5	30	24 / 11 cm	Sitting	horizontal	Table	5-stage	HTC Vive	No	Yes	Yes	Yes
10	5	10	24 / 11 cm	Sitting	vertical	Crane	linear	HTC Vive	Yes	No	Yes	No
11	2.5	45	15 / 7 cm	Sitting	horizontal	Crane	3-stage	Valve Index	No	No	No	No
12	5	30	24 / 11 cm	Sitting	horizontal	Table	5-stage	HTC Vive	No	Yes	Yes	Yes
13	2.5	10	15 / 7 cm	Standing	horizontal	Crane	5-stage	HTC Vive	No	No	Yes	No
14	2.5	30	32 / 15 cm	Sitting	horizontal	Crane	3-stage	Valve Index	No	Yes	No	No
15	2.5	30	15 / 7 cm	Standing	horizontal	Crane	linear	Valve Index	Yes	Yes	Yes	Yes
16	2.5	30	32 / 15 cm	Sitting	vertical	Table	5-stage	Valve Index	Yes	No	Yes	Yes
17	2.5	30	32 / 15 cm	Sitting	vertical	Table	5-stage	Valve Index	Yes	No	Yes	Yes
18	10	10	32 / 15 cm	Sitting	vertical	Table	linear	HTC Vive	Yes	Yes	No	Yes
19	10	30	24 / 11 cm	Sitting	vertical	Crane	linear	Valve Index	No	Yes	No	No
20	10	45	24 / 11 cm	Standing	vertical	Crane	5-stage	Valve Index	No	Yes	No	Yes
21	10	30	15 / 7 cm	Standing	vertical	Table	3-stage	Valve Index	Yes	Yes	Yes	No
22	5	10	24 / 11 cm	Sitting	vertical	Crane	linear	HTC Vive	Yes	No	Yes	No
23	2.5	45	32 / 15 cm	Standing	horizontal	Table	5-stage	HTC Vive	Yes	Yes	Yes	No
24	2.5	45	24 / 11 cm	Standing	horizontal	Table	3-stage	Valve Index	Yes	No	No	Yes
25	10	45	15 / 7 cm	Sitting	horizontal	Table	linear	Valve Index	No	No	Yes	No
26	5	30	24 / 11 cm	Sitting	horizontal	Table	3-stage	HTC Vive	Yes	No	Yes	No
27	5	30	15 / 7 cm	Sitting	vertical	Table	5-stage	HTC Vive	Yes	Yes	No	No
28	12	30	32 / 15 cm	Sitting	horizontal	Table	linear	HTC Vive	Yes	No	No	Yes
29	5	10	32 / 15 cm	Sitting	horizontal	Table	linear	Valve Index	No	Yes	No	No
30	5	15	24 / 11 cm	Standing	vertical	Table	3-stage	Valve Index	No	Yes	Yes	Yes
31	5	30	24 / 11 cm	Sitting	horizontal	Table	3-stage	HTC Vive	Yes	No	Yes	No
32	10	10	15 / 7 cm	Standing	vertical	Table	linear	Valve Index	No	No	Yes	No
33	12	10	24 / 11 cm	Standing	horizontal	Crane	3-stage	Valve Index	Yes	Yes	Yes	Yes
34	10	30	15 / 7 cm	Sitting	vertical	Table	5-stage	Valve Index	No	No	Yes	Yes
35	5	30	15 / 7 cm	Sitting	vertical	Table	5-stage	HTC Vive	Yes	Yes	No	No