We run a post-hoc power analysis using simulation with the simr package in r. First for the unstandardized and then standardized effect sizes

Unstandardized effect size

Model

We run a three level model with a random intercept for level 2 and level 3, obtaining the following results:

```
Linear mixed model fit by REML ['lmerMod']
Formula: outcome ~ predictor + (1 | id_level_2) + (1 | id_level_3)
   Data: data

REML criterion at convergence: 47264.8

Scaled residuals:
    Min      1Q  Median      3Q     Max
-1.3183 -1.0102  0.2102  0.9520  5.4080

Random effects:
 Groups     Name        Variance Std.Dev.
 id_level_2 (Intercept)  137.13  11.710
 id_level_3 (Intercept)   63.38   7.961
 Residual                4490.75  67.013
Number of obs: 4193, groups:  id_level_2, 139; id_level_3, 41

Fixed effects:
            Estimate Std. Error t value
(Intercept)   64.984      2.281   28.49
predictor0     6.712      2.983    2.25

Correlation of Fixed Effects:
           (Intr)
predictor0 -0.514
```

Power for observed effect

Based the observed sample size in each cluster and estimated intra class correlations, we observe the following power for the estimated effect:

```
Power for predictor 'predictor0', (95% confidence interval):
      61.70% (58.61, 64.72)

Test: t-test with Satterthwaite degrees of freedom (package lmerTest)
      Effect size for predictor0 is 6.7

Based on 1000 simulations, (1 warning, 0 errors)
alpha = 0.05, nrow = 4193

Time elapsed: 0 h 1 m 56 s

nb: result might be an observed power calculation
```

Power curve for effect sizes

We now simulate the power for different potential (raw) effect sizes, ranging from 0 to 10.

	Effect size	Power	95% lo	95% hi
1	1	8	6	9
2	2	11	9	13
3	3	17	14	19
4	4	28	26	31
5	5	40	37	43
6	6	52	49	55
7	7	64	61	67
8	8	72	70	75
9	9	84	82	86
10	10	91	89	93

Standardized effect size

Model

We run a three level model with a random intercept for level 2 and level 3, obtaining the following results:

```
Linear mixed model fit by REML ['lmerMod']
Formula: outcome ~ predictor + (1 | id_level_2) + (1 | id_level_3)
   Data: data2
```

```
REML criterion at convergence: 11833.5

Scaled residuals:
    Min      1Q  Median      3Q     Max
-1.3183 -1.0102  0.2102  0.9520  5.4080

Random effects:
 Groups     Name        Variance Std.Dev.
 id_level_2 (Intercept) 0.02921  0.1709
 id_level_3 (Intercept) 0.01350  0.1162
 Residual               0.95662  0.9781
Number of obs: 4193, groups:  id_level_2, 139; id_level_3, 41

Fixed effects:
            Estimate Std. Error t value
(Intercept) -0.03931    0.03329  -1.181
predictor0   0.09797    0.04353   2.250

Correlation of Fixed Effects:
           (Intr)
predictor0 -0.514
```

Power for observed effect

Based the observed sample size in each cluster and estimated intra class correlations, we observe the following power for the estimated effect:

```
Power for predictor 'predictor0', (95% confidence interval):
      62.50% (59.42, 65.51)

Test: t-test with Satterthwaite degrees of freedom (package lmerTest)
      Effect size for predictor0 is 0.098

Based on 1000 simulations, (2 warnings, 0 errors)
alpha = 0.05, nrow = 4193

Time elapsed: 0 h 1 m 58 s

nb: result might be an observed power calculation
```

Power curve for effect sizes

We now simulate the power for different potential standardize effect sizes, ranging from 0 to .

	Effect size	Power	95% lo	95% hi
1	0	6	4	7
2	0.01	6	4	7
3	0.02	8	6	10
4	0.03	12	10	14
5	0.04	14	12	17
6	0.05	21	18	23
7	0.06	29	26	32
8	0.07	38	34	41
9	0.08	44	41	48
10	0.09	54	51	57
11	0.1	61	58	64
12	0.11	70	68	73
13	0.12	76	74	79
14	0.13	84	81	86
15	0.14	87	85	89
16	0.15	95	93	96
17	0.16	96	94	97
18	0.17	97	95	98
19	0.18	99	98	100
20	0.19	99	98	99
21	0.2	99	99	100
22	0.21	100	99	100
23	0.22	100	99	100
24	0.23	100	99	100
25	0.24	100	100	100
26	0.25	100	100	100
27	0.26	100	100	100
28	0.27	100	100	100
29	0.28	100	100	100
30	0.29	100	100	100
31	0.3	100	100	100
32	0.31	100	100	100
33	0.32	100	100	100
34	0.33	100	100	100
35	0.34	100	100	100
36	0.35	100	100	100

37	0.36	100	100	100
38	0.37	100	100	100
39	0.38	100	100	100
40	0.39	100	100	100
41	0.4	100	100	100
42	0.41	100	100	100
43	0.42	100	100	100
44	0.43	100	100	100
45	0.44	100	100	100
46	0.45	100	100	100
47	0.46	100	100	100
48	0.47	100	100	100
49	0.48	100	100	100
50	0.49	100	100	100
51	0.5	100	100	100