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Children's Development of Fairness

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I. Introduction

In this report, I will first discuss how to find the appropriate sample size and show a table of needed sample size with different precision level and confidence level. Then I will discuss the potential problems of the Likert scale, and possible solutions.

II. Appropriate Sample Size

1. Analysis approach

In my analysis, I decided to use the Cochran formula to find the appropriate sample size. The Cochran formula allows you to calculate an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population. The formula is shown below:

$$n_0 = \frac{Z^2 pq}{e^2}$$

n_o: the desired sample size.

Z^2: the z-score of a desired confidence level. Confidence level represents the probability that our estimated interval will capture the true value of the variable that we are interested in. For example, with 95% confidence level, 95 out of 100 samples will have the true population value within the range of precision specified. And a z-score is a numerical measurement of a value's relationship to the mean of a group of values, measured in terms of standard deviations from the mean. For example, the z-score for a 95% confidence level is 1.96.

p: the estimated proportion of an attribute that is present in the population. p can be considered as the degree of variability in the attributes being measured. The more heterogeneous (p with a value closer to 0.5) a population, the larger the sample size required to obtain a given level of precision. Note that a population with p=0.5 has a larger degree of variability than a population with either p=0.2 or p=0.8. This is because p=0.2 and p=0.8 indicate that a larger majority do or do not. I let p=0.5 in my analysis for a conservation propose.

q: equals to 1-p.

e: the desired level of precision. The level of precision is the range in which the true value of the population is estimated to be. For example, if we have a precision level equals to 5%, and our results shown that 60% of the children group 'fairness' with 'moral'. Then our final result should be 55% to 65% of the children group 'fairness' with 'moral' with the determined confidence level.

2. **Results**

From the formula and the explanation above, we can clearly see that if we want a higher confidence level, we need to have a larger sample size. Also, if we want our result to be more precise, we need to have a larger sample size. The table below shows the required sample size for different value of confidence level and precision level. I let p=0.5 and q=0.5 for a conservation propose. The white part shows the sample size. I will recommend a confidence level of 95% and a precision level of 10%, and in this case, we need 96 samples.

			e:desired level of precision										
Confidence Level	Z	Z^2	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.15	0.20
80%	1.28	1.6384	1024	455	256	164	114	84	64	51	41	18	10
85%	1.44	2.0736	1296	576	324	207	144	106	81	64	52	23	13
90%	1.64	2.6896	1681	747	420	269	187	137	105	83	67	30	17
95%	1.96	3.8416	2401	1067	600	384	267	196	150	119	96	43	24
98%	2.33	5.4289	3393	1508	848	543	377	277	212	168	136	60	34
99%	2.58	6.6564	4160	1849	1040	666	462	340	260	205	166	74	42

III. Potential Problems and Possible Solutions of Likert Scale

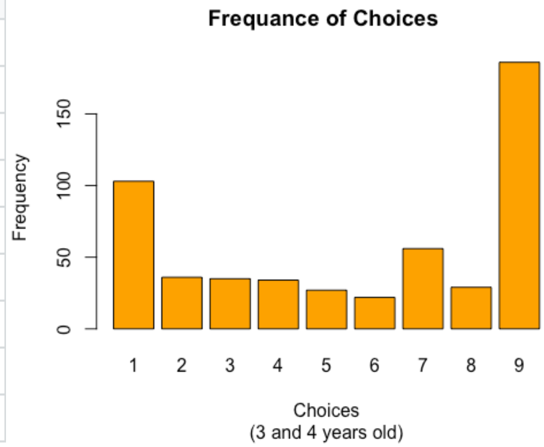
1. **Directionality of a Likert Scale**

A feature of Likert scales is their directionality: the categories of response may be increasingly positive or increasing negative. Although Likert scales fall within the ordinal level of measurement, the intervals between them cannot be presumed equal. For example, in our case, although 8 is worse than 4, we cannot infer that 8 is twice as ‘bad’ as 4. This feature of Likert scale will introduce problems in our analysis especially if we want to use a linear mixed model. One possible solution for this problem is to normalize the data with their category’s mean and standard deviation.

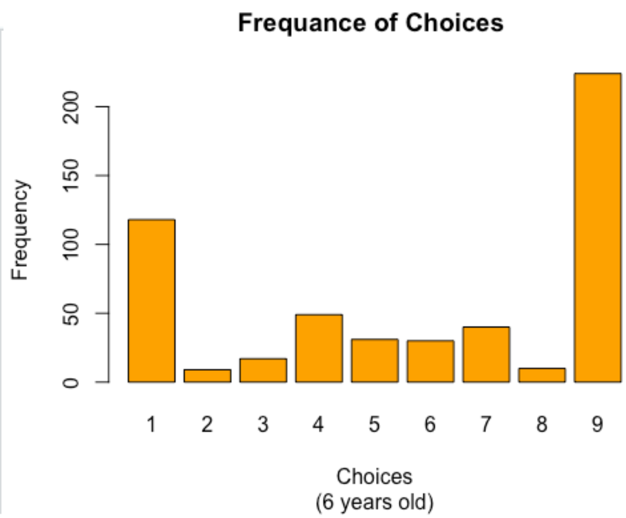
2. **Tendency to Choose an Extreme Number.**

I separated the dataset into 6 years-old and 3 or 4 years-old based on ‘StudyID’. Then I made a frequency table and a boxplot to see the frequency of each number chosen by the respondents. The results are shown below:

	Var1	Freq
1	1	103
2	2	36
3	3	35
4	4	34
5	5	27
6	6	22
7	7	56
8	8	29
9	9	186



	Var1	Freq
1	1	118
2	2	9
3	3	17
4	4	49
5	5	31
6	6	30
7	7	40
8	8	10
9	9	224



From these plots we can see that children at all ages have a tendency to choose 1 or 9. I think there are two potential reasons for this phenomenon. First is that children might have a clear-cut stand for what is good and what is bad. If that is the case, then this tendency to choose extreme number will not affect our analysis. However, another possible reason for this phenomenon is that respondents were not allowed to go back to a previous picture and change rescore. For example, a respondent was first shown a ‘conventional’ picture and gave this picture a ‘9’, then he or she was shown a ‘moral’ picture. Although he or she might feel this ‘moral’ picture is worse than the ‘conventional’ picture, he or she cannot go back and re-score the ‘conventional’ picture. If this is the case it will affect the result of our analysis greatly. Therefore, I think we should allow children to re-score a previous picture.