Appendix C.1

Expanded EDAT (E-EDAT) prompt:

Advertisements for an herbal product, ginseng, claim that it promotes endurance. Prior to accepting this claim, and to determine whether or not this claim is fraudulent, you decide to perform a scientific experiment. Describe your proposed experiment and provide justifications for each aspect of your experimental design. Lastly, state whether the results of your experiment could prove the hypothesis that ginseng promotes endurance. This should take you approximately 10-15 minutes to complete.

Appendix C.2

EXPANDED EDAT (E-EDAT) SCORING RUBRIC			
	0 points given	1 point answer	2 point answer
1. Identifies variable which will be manipulated	Other than Ginseng	Ginseng OR herbal product Note: not required to state that this is the independent variable	N/A
2. Identifies variable which will be measured	Other than endurance	Endurance Note: not required to state that this is the dependent variable	N/A
3. Describes how dependent variable will be measured	Not mentioned OR too subjective and unable to be verified (e.g. "give subjects a survey")	Reasonable outcome measure stated but no specifics/units provided. An activity with variable intensity should specify time and/or distance to receive 2 points. Examples: "run on a track or treadmill" without specifying time "run till tired" without specifying rate of running since subjects could be running at very different speeds	Reasonable outcome measure stated with specifics/units provided. Examples: "distance run in 30 minutes" "heart rate after 20 minute run" "time it takes to run 1 mile" "time run on treadmill with constant speed" "number of push-ups completed before getting tired"
4. Realization that other variables need to be held constant	Not mentioned OR Related to independent variable e.g. type of ginseng administered	Stated one reasonable variable that would be controlled Examples: -Related to subjects in trial (e.g. age, gender, ethnicity, fitness level, athleticism) -Related to environmental conditions during test (e.g. humidity, temperature, time of day) -Related to test itself (e.g. holding time constant between ginseng ingestion and endurance test) -Using same group of people for control group and test group (inherently controlled) -Randomly assigning individuals to control and treatment group (implying need to control subjects' attributes) -Acknowledgement that other variables need to be held constant without naming them specifically e.g. "many variables have to be controlled"	Stated two or more reasonable variables from examples under "1 point answer"

Appendix C.2

5. Placebo or Vehicle effect: Recognition that "control" group should be kept as similar as possible to experimental groups	Not mentioned	Recognize need for placebo control but do not provide reasoning or provide incorrect/insufficient reasoning Examples: -Mention the word "blind" but do not explain what subjects are blinded from or why this is important (e.g. "do a blind experiment" -"participants should not be told what the study is testing i.e. ginseng effect on endurance" -"participants should not be told that they are in an experiment" -"placebo given to control for psychological effects"	Recognize need for placebo control and provide correct reasoning for this control Examples: "give one group a sugar pill and one group a ginseng pill" (implied that these are indistinguishable) "give both groups a similar looking treatment e.g. water and water + ginseng"
6. Sample size	Not mentioned	State large sample size but no reasoning or incorrect/vague reasoning provided Examples: "enough people for the study to make sure your results are accurate" "to increase accuracy " or "reduce distortion" "to obtain an average" "to get more valid data" "to eliminate outliers" (this is inaccurate since you do not eliminate the outlier, you decrease the effect of outliers) "more data is always better"	State large sample size and provide correct reasoning Examples: Need large numbers to obtain statistical significance, decrease effect of outliers **OR** to account for natural variability which exists within a population
7a. Repeat experiment	Not mentioned OR "NO", OR a possibility e.g. "experiment can be repeated"	YES, recognizes need to repeat an experiment	N/A
7b. Reasoning for repeating experiment	No explanation given OR incorrect reasoning e.g. "to increase sample size" or "so that a different variable can be changed"	Recognition that repeating an experiment will increase validity of results, but not making it clear that they understand why this is the case Examples: "to have more numbers" "more data is better" Need to repeat experiment to have more numbers/obtain statistical significance/**increase sample size** (recognition that repeating experiment will increase validity of results, but not making it clear that they understand **why** this is the case)	Provided appropriate justification for why it is important to repeat an experiment Examples: Recognition that there are external environmental or procedural differences impacting the study that may not have been recognized or controlled for (e.g. time of year, time of day, person implementing the trial, equipment used for measurements, other factors impacting participants)
8a. Conclusions that could be drawn	Not mentioned OR stated only as part of hypothesis/prediction	States what conclusion can be drawn but does not qualify the conclusion	States what conclusion can be drawn and qualifies the conclusion indicating an awareness that there are possible sources of

8a. Conclusions that could be drawn	Not mentioned OR stated only as part of hypothesis/prediction e.g. "we predict that people given ginseng will have increased endurance"	States what conclusion can be drawn but does not qualify the conclusion Example: "this study will show whether ginseng increases endurance" Note: 1 pt credit given for 8a if students make a hypothetical statement after they describe their experiment e.g. "if ginseng works we expect to see increased endurance" since many students did not consider their proposed experiment to have been completed.	States what conclusion can be drawn and qualifies the conclusion indicating an awareness that there are possible sources of error and that there are limits to generalizing a conclusion. Example: "under these conditions" "with this set of people" Note: 1 point credit given for 8a if student qualifies the potential findings even if no conclusion explicitly stated
8b. Results cannot prove your hypothesis	Not mentioned OR YES, can prove hypothesis	Recognition that you <u>cannot prove a hypothesis</u> but did not provide any reasoning/explanation Example: "No, this experiment alone cannot prove the hypothesis" Note: 1 pt credit given for "this experiment could show that	Recognition that you cannot prove a hypothesis but <u>can only disprove a hypothesis</u> or <u>build support for a hypothesis</u> Examples: "If ginseng increases endurance more than placebo this would suggest that the hypothesis is correct"

Total points = 17