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Within-Subjects Repeated-Measures Design

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Within-Subjects Repeated-Measures Design

Overview:

A within-subjects design is an experimental design where all the participants receive every level of the treatment, i.e. every independent variable. For example, in a candy taste test, the researcher would want every participant to taste and rate each type of candy.

This video demonstrates a within-subjects experiment (i.e., one where there is one independent variable with several variations or levels) that examines how different motivational messages (e.g., hard work, self-affirmation, outcomes, positive affect) influence willingness to exert physical effort. As a within-subjects design, the participant will read each of the 4 types of motivational messages and then have their physical effort measured via lifting weights. By providing an overview of how a researcher conducts a repeated-measures experiment, this video allows viewers to see how to address order effects through counterbalancing, which involves a systematic approach to making sure all possible orders of the conditions occur in the study.

Comment [AK1]: Do we want to explain what counterbalancing is a bit further here? Perhaps this won't be readily obvious to a student?

Psychological studies often use higher sample sizes than studies in other sciences. A large number of participants helps to better ensure that the population under study is better represented and the margin of error accompanied by studying human behavior is sufficiently addressed.
In this video we demonstrate this experiment using just one participant. However, as represented in the results, we used a total of 72 participants to reach the experiment's conclusions.

Procedure:

1. Define Key Variables

1.1. Create an operational definition (i.e. a clear description of exactly what a researcher means by a concept) of a "motivational message."

1.1.1. For the purposes of this experiment, a "motivational message" is any combination of image and phrase designed to energize a person's behavior, manipulated here by viewing a series of images accompanied by empowering quotes focusing on one of 4 areas: hard work, self-affirmation, outcomes/success, general positive feelings/emotions (Figures 2-5, attached below).

1.2. Create an operational definition (i.e. a clear description of exactly what a researcher means by a concept) of "effort."

1.2.1. For purposes of this experiment, "effort" is defined as the participant's willingness to exert physical strength on a weight-lifting task.

2. Conducting the Study

2.1. Meet student/participant at the lab.

2.2. Provide participant with "informed consent," a brief description of the research (influences on physical behavior), a sense of the procedure, an indication of potential risks/benefits, the right of withdrawal at any time, and a manner to get help if they experience discomfort.

2.3. Determine the order of conditions through counterbalance

2.3.1. It is important to address order effects. If conditions were always in the same order the later conditions would likely perform worse because participants would be tired.

2.3.2. Counterbalance conditions~~, which~~ involve~~s~~ a systematic approach by which the researcher insures that ~~to make sure~~ every order occurs during the study and that each condition occurs the same number of times in each of the spots ~~the same spot~~ in the order.

Comment [AK2]: A definition of this term can be inferred, but it seems important enough to want to state it explicitly.

2.3.3. Each participant receives only one order

2.3.4. Determine all possible orders of the four conditions

H = Hard Work; S = Self-Affirmation;
O = Outcomes; P = Positive Emotion

HSOP	SHOP	OHSP	PHSO
HSPO	SHPO	OHPS	PHOS
HOSP	SOHP	OSHP	PSHO
HOPS	SOPH	OSPH	PSOH
HPSO	SPHO	OPHS	POHS
HPOS	SPOH	OPSH	POSH

2.3.5. Put each of the 24 possible orders on a slip of paper, place all slips in a bowl.

2.3.6. Researcher selects one slip and proceeds to run the experiment in that order. This randomly selects one of the counterbalanced orders. The researcher should not replace the order in the bowl so that every order gets done once before repeating any one order a second time.

2.4. Run the conditions (NOTE: the researcher will run all 4 conditions using these exact same steps. The only difference will be the image the participant views. The same participant will be shown doing all 4 conditions)

Comment [AK3]: What about resting? Do you need to control for fatigue?

Comment [GWL4]: This is a common issue with these designs. If you'd prefer, we can simply build in a 30-60sec break in between

2.4.1. Show the participant a page sized printout of the image/quote while the participant sits at a table.

2.4.2. Tell the participant: "please read this over and take a minute to reflect on what it means to you."

2.4.3. After a minute say "please stand and take this 10 pound dumbbell in your dominant hand. Complete as many curls as you'd like to in the next 30 seconds (researcher should show the curl motion with their own arm). Count aloud as you complete each one."

2.4.4. The researcher will note the participant's number on a sheet.

Participant	Order	Hard Work	Self-Affirmation	Outcomes / Success	Positive Feelings
1	SOHP	10	6	5	3
2					
3					
4					
5					

3. Debrief

3.1. Participant is told the nature of the study.

3.1.1. "Thank you for participating. In this study I was trying to determine if different types of motivational messages would increase the amount of physical effort participants were willing to exert. There were four types of messages: one emphasizing hard work, one emphasizing what a good person you are, one emphasizing successful outcomes, and one that was generally positive. We hypothesized that the message emphasizing hard work would result in exerting more physical effort."

3.2. Explain explicitly why deception was necessary for the experiment.

3.2.1. "We couldn't tell you about our hypotheses ahead of time because we wanted you to act as naturally as possible."

4. Results:

Figure 1. Number of Times Lifting the Weight by Motivational Message Type

4.1. The procedure was run for 24 counterbalanced orders 3 times, so data was collected from 72 total participants. Numbers above reflect the number of times participants in each condition lifted the weight. Results above are the means for the 72 participants in each condition.

4.2. A large number of participants is necessary to ensure that the results are reliable. If this research were conducted using just a few participants, it's likely that the results would have been much different, and not reflective of the greater population.

4.3. To determine if there were differences between the motivational messages on physical effort, we performed a repeated-measures analysis of variance (ANOVA).

4.4. The results indicate that participants who read the hard work motivational message exerted more physical effort by doing more curls of the 10 pound weight in 30 seconds.

5. Applications:

5.1. This repeated-measures within-subject experiment shows how researchers use a study design to compare participants' experiences in one context to their own experiences in another context. Or in other words, how researchers compare participants to themselves.

5.2. Repeated-measures within-subjects designs are particularly common in functional magnetic resonance imaging (fMRI) research where participants lay in an fMRI machine while experiencing several conditions to see how the brain reacts to different experiences.

Comment [GWL5]: One of the real benefits of this type of design is that it actually does a better job of accounting for individual variations because the participant is always compared to him/herself. Those will higher abilities will have higher abilities on all sections but their relative performance is relative to themselves. These kinds of issues are also counteracted by having large samples. (to that last point, if you prefer we could just as easily say we ran the 24 sets 6 times for a total of 144 participants)

Comment [AK6]: How is physical strength and fatigue accounted for in a design like this? I realize that counterbalancing can help to limit the effects of variation amongst individuals physical abilities, but what if, by chance, individuals who are stronger and less likely to fatigue are randomly assigned orders that bias the data to the hard work condition (ie, hard work near the beginning or end).

5.3. For example, an fMRI study wanted to determine which areas of the brain correlate with feelings of long-term intense romantic love (Acevedo, Aron, Fisher, & Brown, 2012). To test this, participants saw each of the following images: a highly familiar acquaintance, a close long-term friend, a low-familiar person, and their long-term romantic partner. Analyses indicated that the long-term romantic partner activated areas of the brain (e.g., the ventral tegmental area (VTA) and dorsal striatum) associated with the dopamine reward system, and areas (e.g., globus pallidus and substantia nigra) associated with emotional attachments.

Comment [DM7]: Do we have imagery in the vault we could use here Aaron?

References

Acevedo, B. P., Aron, A., Fisher, H. E., & Brown, L. L. (2012). Neural correlates of long-term intense romantic love. *Social Cognitive And Affective Neuroscience*, 7(2), 145-159. doi:10.1093/scan/nsq092

Figure 1. Number of Times Lifting the Weight by Motivational Message Type

Figure 2: Hard Work

Figure 3: Self Affirmation

Figure 4: Outcomes/Success

Figure 5: General positive feelings and emotions

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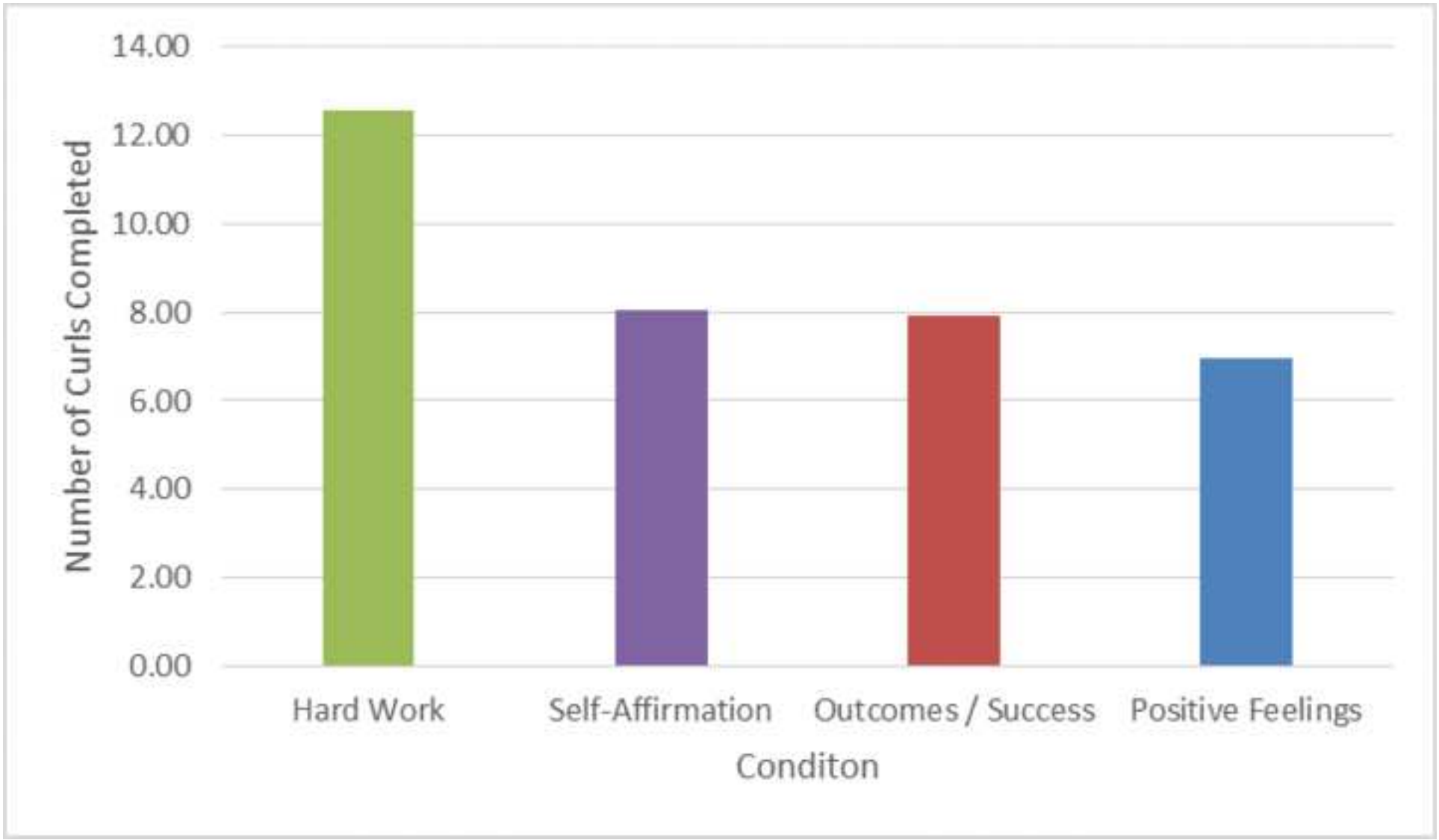

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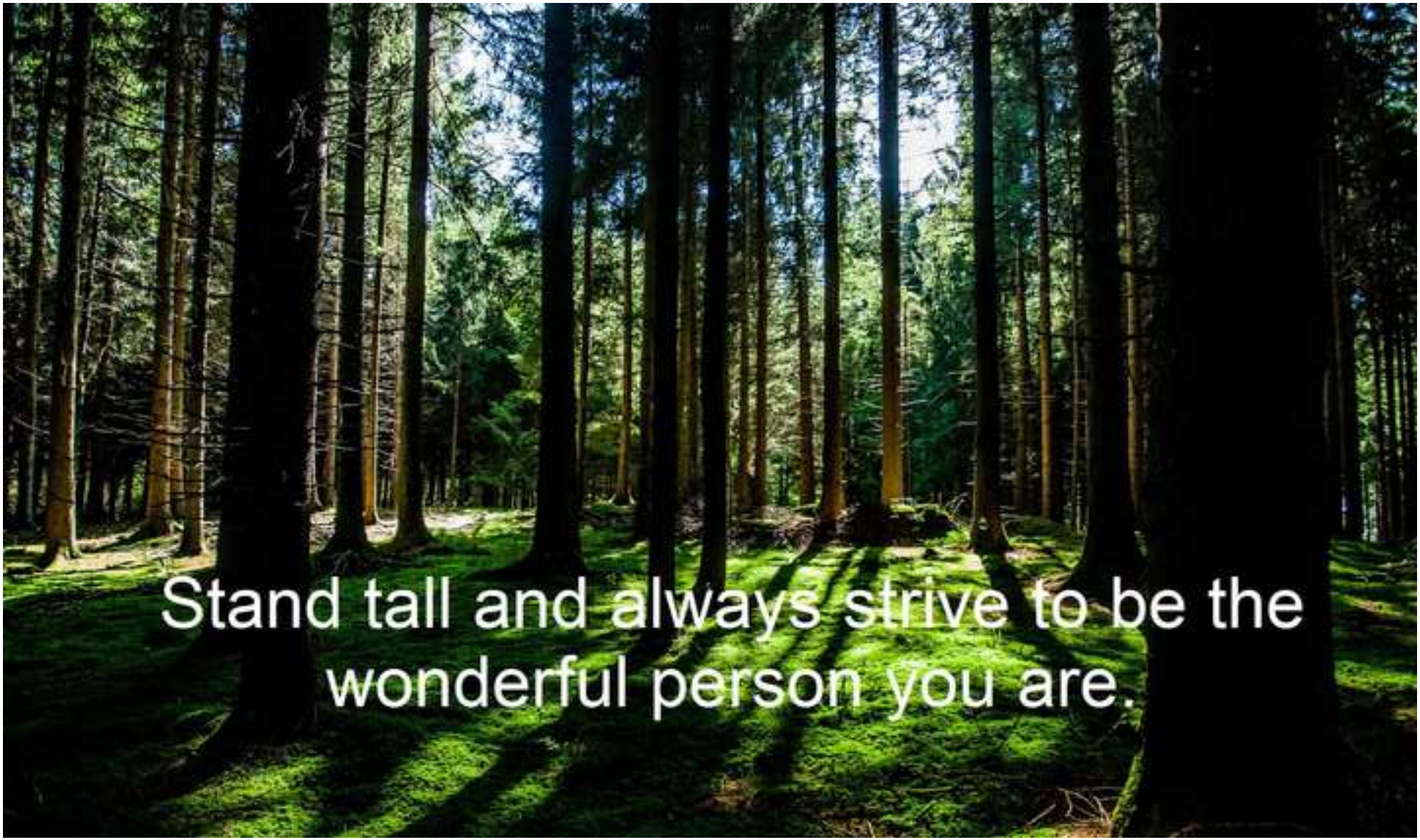

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