

Virtual Reality, Process Safety, And Counterfactual Thinking--New Paradigm For Training?

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Introduction

Counterfactual Thinking: considering alternatives to past events (Byrne, 2016; Roese, 1997). Such thoughts typically occur after negative events and facilitate motivation, intention, and general goal-pursuit behavior (Dyczewski & Markman, 2012; Markman et al., 2008; Medvec et al., 1995; Smallman & Roese, 2009). Recent work proposes that workplace safety could be improved if people engage in counterfactual thinking after unsafe episodes (He et al., 2020).

Downward counterfactuals (how things could have been worse)
- can increase positive affect

Upward counterfactuals (how things could have been better)
- can increase negative affect

- which can increase behavioral intentions and future behavior
(Epstude & Roese, 2008; Markman et al., 1995; Roese, 1994; Smallman, 2013)

According to functional theory of counterfactual thinking:
These cognitive musings can be used to improve future situations by highlighting changes needed for a different outcome
(Epstude & Roese, 2008; Roese & Epstude, 2017).

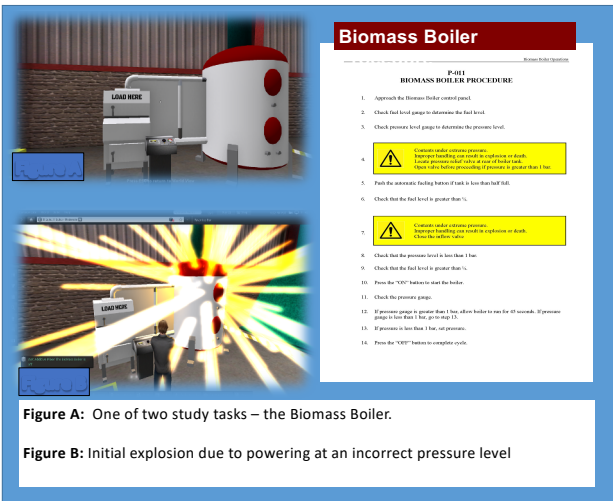
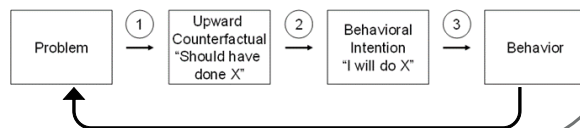


Figure A: One of two study tasks – the Biomass Boiler.

Figure B: Initial explosion due to powering at an incorrect pressure level

Main question

Can counterfactual thinking be used to improve workplace safety and adherence to procedures?

Method

Participants: 150 undergraduates (50 per condition)

Research design: Experiment (1x3) in SecondLife simulation.

Two tasks (counter-balanced) with participants following procedures (see Figures A&B).

Tasks designed to likely produce negative outcomes without careful attention to the safety steps.

Between tasks, participants engage in a counterfactual condition:



Conditions:

- **“Good” Counterfactual:** “After these sorts of experiences (like the one you just had doing the warehouse task), people sometimes cannot help thinking ‘what if...’ or ‘if only...’ and imagine how things might have been better.”
 - Participants then identify as many naturally occurring good counterfactuals (e.g., ‘If only I... then it could have been better’) in a text box on screen.
- **“Bad” Counterfactual:** “After these sorts of experiences (like the one you just had doing the warehouse task), people sometimes cannot help thinking ‘what if...’ or ‘if almost...’ and imagine how things might have been worse.”
 - Participants then identify as many naturally occurring bad counterfactuals (e.g., ‘If... then it could have been worse’) in a text box on screen.
- **Fact Listing (control):** “After these sorts of experiences (like the one you just had doing the warehouse task), people differ in their responses when asked to recall the task.”
 - Participants then identify as many naturally occurring facts about the warehouse task (i.e., what happened, when it happened, who was involved, etc.) in a text box on screen.

Dependent variables:

- (1) Performance : completion, adherence to safety steps, adherence to procedure overall.
- (2) Task performance questionnaire
- (3) Workplace safety questionnaire

Hypothesis: For the 2nd task, those participants in good counterfactuals condition will have: better performance, perceive better task performance, and perceive better workplace safety than participants in the bad counterfactual and control conditions.

Challenges with Virtual Reality

- Two virtual tasks embedded in 2nd Life ® warehouse.
- Important element was occurrence of a major incident with obvious consequence.
- Designed equipment to explode (including audio) when procedure not follow correctly
- See Figures A & B
- Pilot testing: 13 Participants – Incident occurrence was extremely unbalanced despite counter-balance
- Had to make both tasks equally difficult

Challenges with COVID: Online Study

Data collection was initially planned for face to face
Not possible in a pandemic

A fully-virtual safety and procedures-based study presents several challenges:

- Training videos and procedures temporarily available to participants via Google Drive permission.
 - implemented to ensure protection of study materials.
- Participants will
 - download software and create 2nd Life account
 - utilize Zoom w/ screen sharing
- Challenges
 - participants must have correct computer specs
 - consent process must take place entirely online
 - sufficient equivalency of environment between participants

What's next

- Data collection currently underway
 - completed Fall 2020
- Write up and publication, Spring 2021