Interactive Narratives, Counterfactual Thinking and Personality in Video Games

Catherine A. Bacos(✉), Michael P. McCreery, and Jeffrey R. Laferriere

University of Nevada, Las Vegas, NV 89154, USA
catherine.bacos@unlv.edu

Abstract. Interactive narratives in video games allow players to experience a variety of storyline pathways, inviting players to think about alternative choices that might lead to different outcomes. These branching story structures can induce counterfactual thinking, the process of forming mental representations of past events to imagine alternative outcomes. Video games can be used to track and analyze behaviors during gameplay that are indicative of cognitive processes. As a gameplay analytics approach to assessing such behaviors, video games afford the measurement of factors that may influence those behaviors. Little is known about how personality influences the use of counterfactuals. As such, the focus of the present study was to investigate the effect of the Big Five personality traits (i.e., agreeableness, conscientiousness, emotional stability, extraversion, and intellect) on in-game behaviors indicative of counterfactual thinking (CFT). Participants ($N = 132$) played an interactive, narrative-based video game twice. In-game behaviors indicative of CFT (i.e., changes in answer choices across gameplays) were coded and analyzed to determine whether they were dependent on participants' in-game experiences (i.e., outcomes and valence of answer choices) and individual differences (i.e., personality dimensions). The outcome of failure and the valence of answer choices in the first gameplay had significant effects on CFT. The results also indicated a significant interaction between the outcome of the first gameplay and conscientiousness in their effect on CFT. Implications for these findings are discussed.

Keywords: Interactive narratives · Counterfactual thinking · Personality
Video games · Behavior regulation · Assessment

1 Introduction

Games provide a venue for enacting mental simulations that may not be possible in the real world. Not only can alternative pathways be imagined, but in a game, the player can carry out and experience the imagined alternative path. Primed by in-game experiences, mental simulations of alternative pathways in a game are cognitive processes players rely on to inform their in-game decisions. Such internal cognitive processes, though unobservable, may be inferred from behaviors [1]. Games can be used to analyze such behaviors, and through behaviors, mental processes [2].

C. Stephanidis (Ed.): HCII Posters 2018, CCIS 850, pp. 340–347, 2018.
https://doi.org/10.1007/978-3-319-92270-6_49

1.1 Personality

To better understand how thinking influences behavior, one should begin to examine underlying individual differences. A significant factor known to influence a person's behavior is personality [3]. According to trait theory, individual differences exist along a set of dispositional traits that make up a person's personality. Relatively stable and enduring, these traits may predict whether an individual is more likely to exhibit certain behaviors. Trait dimensions can be identified using personality scales and statistical analysis. The most well-known model for describing personality is the Big Five, which identifies five major dimensions of personality: agreeableness, conscientiousness, emotional stability, extraversion, and intellect [4]. Genes and the environment appear to influence Big Five traits [4]; and despite differences in levels across cultures, Big Five traits seem to be universal [5].

1.2 Counterfactual Thinking

Another individual difference that can influence behavior is the tendency of some individuals to engage in cognitive processes such as counterfactual thinking. Current theory proposes that counterfactual thinking is strongly connected to course correction, goal cognition, and behavior regulation [6]. Counterfactual thinking, the process of forming mental representations of past events to imagine alternative outcomes, involves thoughts about how things could have been better (i.e., upward counterfactual thinking) or how things could have been worse (i.e., downward counterfactual thinking). Negative outcomes are known to influence the production of counterfactuals [7]. For example, in situations where one experiences a failed goal, counterfactual thinking is used to consider another way to achieve that goal [6].

In a study highlighting the importance of taking both individual differences and contextual factors into account when predicting counterfactual thinking, the use of counterfactuals was compared between participants who read versus acted out scenarios designed to induce counterfactual thinking [8]. The results showed that readers focused more on the choice options and actors focused more on the problem features of the scenario, indicating that the role (i.e., passive versus active) and the context in which the individual acquires information matters in terms of the function of counterfactual thinking [8]. These findings demonstrate the need to assess counterfactual thinking in various roles and environments.

1.3 Video Games as Behavioral and Cognitive Assessments

As an alternative to research procedures that explicitly and obtrusively ask participants through experimental prompts or self-report measures to engage in counterfactual thinking, the use of video games can serve as a game analytic approach to collect data on participants' spontaneous use of counterfactual thinking. This natural approach allows researchers to draw more definite conclusions about the antecedents and consequences of counterfactual thinking as it occurs spontaneously [9]. Since cognitive processes can be inferred from behavior [1], behaviors that indicate the use of counterfactual thinking can be observed in video games. The ability to track and analyze player performance and

behaviors indicative of cognitive processes in a controlled and replicable setting is an affordance of video games that make them an ideal medium for assessing how individuals regulate their behavior to reach a goal (e.g., problem solving) [2]. Using games, researchers can assess in-game behaviors such as decision-making and problem-solving and compare them to other measures related to the player and their environment.

1.4 Interactive Narratives and Counterfactual Thinking

Interactive narratives such as those found in nonlinear video games are especially ideal for assessing players' regulation of behavior because interactive narratives are essentially an exercise in counterfactual thinking [10]. Branching narrative structures allow players to experience a variety of storyline pathways and require course correction, goal cognition, and behavior regulation as the players plot and re-plot their decisions. Such in-game behaviors, indicative of cognitive processes, may be attributed to an individual's in-game experiences. For example, players will learn to adjust or "tune" their behaviors in response to in-game experiences such as failed outcomes [11]. The theory of counterfactual thinking may also serve as an explanation for the player's motivation to engage in such choice behavior changes. Additionally, individual differences associated with personality traits may also contribute to these behaviors as they have been shown to impact how behavior manifests in vivo [12] and in video games [13].

While there have been several studies on the tendency of individuals with certain narrow traits to use counterfactual thinking (e.g., optimism and self-esteem) [14, 15], there have been very few published studies on the effect of broader dimensions of personality on counterfactual thinking (CFT). To address this gap, the present study investigated the effect of personality traits (i.e. Big Five personality dimensions) on in-game behaviors indicative of CFT (i.e., changes in answer choices across gameplays). Since these measures were taken in the context of an interactive narrative-based video game, the in-game experiences (i.e., outcome and valence of answer choices) were also considered as potential factors. To explore these variables, the following research questions framed the study:

1. **Effect of Game Experiences on CFT.** Do in-game experiences (i.e., outcome of the first gameplay and valence of answer choices in the first gameplay) predict behavioral choices indicative of counterfactual thinking (i.e., changes in answer choices across gameplays)?
2. **Effect of Personality on CFT Depending on Outcome.** Depending on the outcome of the first gameplay, do Big Five personality dimensions predict behavioral choices indicative of counterfactual thinking (i.e., changes in answer choices across gameplays)?

2 Method

2.1 Participants

Participants were recruited through a subject pool from a college of education in the southwestern United States. A power analysis was conducted to determine sample size for the largest model. Results (f2 = .15; level = .8; p = .05; Cohen, 1992) indicated that

a minimum of 67 subjects was needed to analyze the largest model. One hundred and forty-seven completed the present study, however only 132 participants were included in the data analysis due to incomplete data sets. Gender demographics for the sample consisted of 36 males and 96 females. A gender breakdown such as this is consistent with colleges of education [16]. The racial makeup of the sample was: 45.5% White, 7.6% Black or African-American, 17.4% Hispanic or Latino, 16.7% Asian, 2.3% Native Hawaiian or Pacific Islander, and 10.6% who reported two or more races. The average age of the sample was approximately 25 (sd = ∼7) years old.

2.2 Materials and Procedures

Instruments. For this study only two sets of instrumentation data were collected. The first set was personality dimension scales (i.e., agreeableness, conscientiousness, emotional stability, extraversion, and intellect) from the IPIP Big 5 Personality Scales [17]. Each of these scales is a 10-Item, 5-point, Likert-type questionnaire. Psychometric data provided by the author [17] showed good reliability with internal consistency coefficients of .79 and .84 respectively. The second set of data collected consisted of a questionnaire collecting demographic and gameplay feedback data.

The Deed Video Game. The Deed [18] is a single-player roleplaying video game with a branching storyline known as an interactive narrative. In games with branching narratives, players are forced to make choices that will lead to several possible outcomes. The Deed is a murder mystery in reverse as the objective is to plot a crime rather than solve it. A combination of player choices leads to seven possible outcomes in the game, which can be broken into three outcome categories: (1) failure (i.e., conviction of murder), (2) partial success (i.e., unsolved murder, no conviction), and (3) complete success (i.e., a non-player character is found guilty for the murder). The Deed begins with the choice to play the introduction during which players learn about the character they will play, a young man who returns home after discovering his father's plans to disinherit him in favor of his sister, and receive instructions related to plotting the murder of the sister. Players are instructed to converse with the relatives and search the house for useful objects (i.e., items of evidence and weapons). Two objects must be selected before the narrative can advance to the second part of the game, the dinner celebrating the father's birthday. The third part is committing the murder, and the final part is the interview with the crime investigator. The interview is followed by the game outcome.

Procedures. This study was part of a larger study examining video games as stealth assessments. For brevity, only the procedures of the current study are reported. The procedures included two plays of the video game The Deed [18] followed by the completion of a questionnaire collecting demographic and gameplay feedback data, and the completion of personality dimension scales (IPIP Big 5 Personality Scales) [17]. All participants provided informed consent to participate in the study in line with the Institutional Review Board (IRB) requirements at the data collection site.

Gameplay Analytics. The game elements of The Deed [18] were deconstructed to identify the multiple narrative pathways in the game. In the first part of the game, players can choose to interact with up to five non-player characters (NPCs): maid, butler, father, mother, and sister. Players can choose to respond to several possible questions from NPCs; six of the questions are mandatory. That is, those same six questions appear in each gameplay and players must respond to them to advance the narrative. For this study, only those six questions were measured to score participants' changes in response choices across gameplays. Video gameplays of each subject were recorded using Fraps [19]. Subjects' first and second gameplays were coded for outcomes. The following behavioral choices were coded and analyzed: (1) total number of changes to answer choices in response to non-player characters across gameplays and (2) the total valence (i.e. positive or negative value) of answer choices in the first gameplay.

3 Results

3.1 Data Normalcy

Prior to answering the research questions, data normalcy was assessed for skewness and kurtosis. Although disagreement exists related to absolute values (i.e., 2 or 3) associated with skewness and kurtosis [20], for the current study the absolute value of 2 was applied. Results of the analysis indicated that all variables fell with within acceptable limits.

3.2 Effect of Game Experiences on CFT

To answer question one, dummy coding was used to code the categorical variables for the three outcomes of the first gameplay (i.e., failed, partially failed, and successful) so that the variables of interest (i.e., failed outcomes, which are associated with counterfactual thinking) could be analyzed in multiple regression. Table 1 shows the two dummy coded variables. A simultaneous regression analysis was conducted to predict the number of changes in response choices across gameplays (i.e., CFT) from the two dummy variables and the valence of answer choices in the first gameplay (Valence A). A significant regression equation was found, $F(3,128) = 11.844$, $p < .001$, $R2 = .217$ (see Table 2). The Fully Failed outcome was a statistically significant predictor of CFT ($b = 1.119$, $SE = .432$, $p = .006$, 95% CI = .344, 2.055; $\beta = .337$). The Partially Failed outcome was a statistically significant predictor of CFT ($b = 1.109$, $SE = .503$, $p = .029$, 95% CI = .114, 2.104; $\beta = .268$). Valence A was a statistically significant predictor of CFT ($b = -.475$, $SE = .088$, $p = .000$, 95% CI = −.650, −.301; $\beta = -.422$).

Table 1. Conversion of three categorical variables into two dummy variables.

Group	Fully Failed Outcome A	Partially Failed Outcome A
1. Fully Failed	1	0
2. Partially Failed	0	1
3. Successful	0	0

Table 2. Effect of game experiences on CFT.

Variable	*B*	β	*t*	*p*
Fully Failed	1.199	.337	2.775	.006
Partially Failed	1.109	.268	2.205	.029
Valence A	−.475	−.422	−5.397	.000
R^2	.217			
F	11.844			.000

3.3 Effect of Interaction on CFT

To answer question two, whether the effect of personality dimensions on CFT (i.e., changes in answer choices across games) depend on the outcome of the game, simultaneous linear regression analyses were conducted to test the interaction between Outcome A (i.e., the outcome of the first gameplay) and each of the Big Five dimensions of personality (i.e., agreeableness, conscientiousness, emotional stability, extraversion, and intellect). To analyze the interaction varialbe in multiple regression, a dummy variable was created for Outcome A (i.e., no win and win), the values for each of the personality dimensions were centered, and cross-products between those variables were created (e.g., Interaction OutA_Con means the interaction between Outcome A and Conscientiousness). A significant interaction was found for Outcome A and the personality dimension of conscientiousness (see Fig. 1 and Table 3). For subjects with successful outcomes (i.e., win), conscientiousness had a negative effect on CFT, but little effect on the subjects with failed outcomes (i.e., no win).

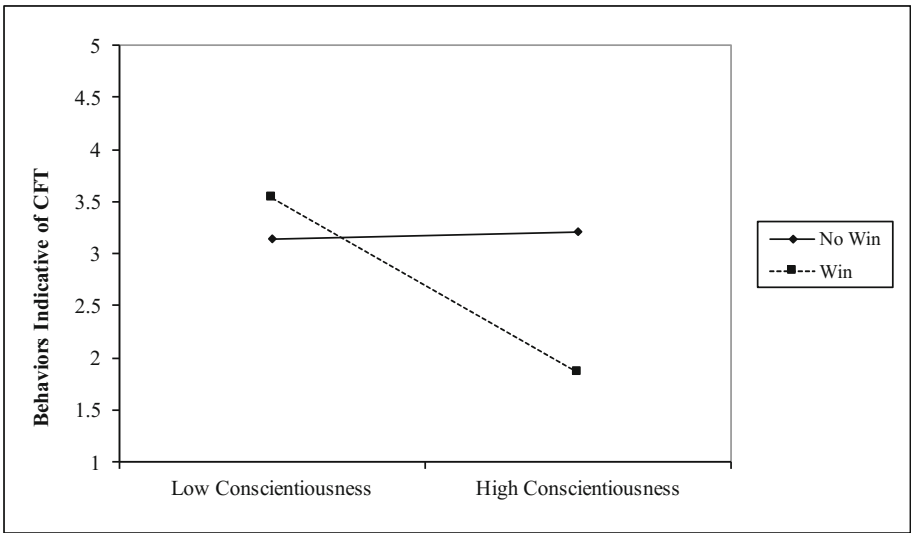

Fig. 1. Regression lines illustrating the interaction of Outcome A (i.e., no win and win) and the personality dimension conscientiousness in their effects on behaviors indicative of CFT (i.e., changes in answer choices across games).

Table 3. Effect of interaction between Outcome A and conscientiousness on CFT.

Variable	*B*	β	*t*	*p*
Outcome A	−.486	−.137	−1.631	.105
Conscientiousness	.006	.020	.193	.847
Interaction OutA_Con	−.167	−.310	−3.055	.003
R^2	.104			
F	4.952			.003

4 Discussion

The present study employed a gameplay analytics approach to determine whether in-game behaviors indicative of counterfactual thinking, CFT (i.e., changes in answer choices across gameplays), were dependent on participants' individual differences (i.e., personality traits) and in-game experiences (i.e., failed outcome and answer choice valence of first gameplay). The outcome of failure and the valence of answer choices in the first gameplay both had significant effects on CFT. As failed outcomes increased, CFT was predicted to increase. As valence (i.e., positive or negative value of answer choices) increased, CFT was predicted to decrease. In addition, the results indicated a significant interaction between the outcome of the first gameplay and conscientiousness in their effect on CFT. These findings suggest that for subjects with successful outcomes, higher levels of conscientiousness will result in a decrease in behaviors indicative of counterfactual thinking. For subjects with failed outcomes, however, it appears that conscientiousness has little effect on behaviors indicative of counterfactual thinking. While conscientiousness, depending on gameplay outcomes, influences counterfactual thinking, the game environment (i.e., interactive narrative) serves as a natural catalyst for counterfactual thinking because the interactive narrative, by design, is an exercise in counterfactual thinking. Altogether, the results of the study suggest the game environment, game experiences, and individual differences should all be considered to understand how these interrelated variables contribute to the overall effect on the use of counterfactual thinking for behavior regulation.

References

1. Mayer, R.E.: Thinking, Problem Solving, Cognition. WH Freeman/Times Books/Henry Holt & Co. (1992)
2. Shute, V.J., Wang, L., Greiff, S., Zhao, W., Moore, G.: Measuring problem solving skills via stealth assessment in an engaging video game. Comput. Hum. Behav. **63**, 106–117 (2016). https://doi.org/10.1016/j.chb.2016.05.047
3. Hogan, R., Johnson, J., Briggs, S. (eds.): Handbook of Personality Psychology. Academic Press, San Diego (1997)
4. McCrae, R.R., Costa, P.T.: Personality in Adulthood: A Five-Factor Theory Perspective. The Guilford Press, New York (2003)

5. Heine, S.J., Buchtel, E.E.: Personality: the universal and the culturally specific. Annu. Rev. Psychol. **60**, 369–394 (2009). https://doi.org/10.1146/annurev.psych.60.110707.163655
6. Epstude, K., Roese, N.J.: The functional theory of counterfactual thinking. Personal. Soc. Psychol. Rev. **12**, 168–192 (2008). https://doi.org/10.1177/1088868308316091
7. Roese, N.J.: The functional basis of counterfactual thinking. J. Personal. Soc. Psychol. **1994** (66), 805–818 (1994). https://doi.org/10.1037/0022-3514.66.5.805
8. Girotto, V., Ferrante, D., Pighin, S., Gonzalez, M.: Postdecisional counterfactual thinking by actors and readers **18**, 510–515 (2007). https://doi.org/10.1111/j.1467-9280.2007.01931.x
9. Sanna, L.J., Turley, K.J.: Antecedents to spontaneous counterfactual thinking: effects of expectancy violation and outcome valence. Personal. Soc. Psychol. Bull. **22**, 906–919 (1996). https://doi.org/10.1177/0146167296229005
10. Green, M.C., Jenkins, K.M.: Interactive narratives: processes and outcomes in user-directed stories. J. Commun. **64**, 479–500 (2014). https://doi.org/10.1177/0146167296229005
11. Schrader, P.G., McCreery, M.P., Vallett, D.: Performance in situ. In: Baek, Y. (ed.) Game-Based Learning: Theory, Strategies and Performance Outcomes. Nova Science Publishers, Hauppauge (2017)
12. John, O.P., Robins, R.W., Pervin, L.A. (eds.): Handbook of Personality. The Guilford Press, New York (2010)
13. McCreery, M.P., Kathleen Krach, S., Schrader, P.G., Boone, R.: Defining the virtual self: personality, behavior, and the psychology of embodiment. Comput. Human Behav. **28**, 976–983 (2012). https://doi.org/10.1016/j.chb.2011.12.019
14. Kasimatis, M., Wells, G.L.: Individual differences in counterfactual thinking. In: Roese, N. J. (eds.) What Might Have Been: The Social Psychology of Counterfactual Thinking, pp. 81–101. Lawrence Erlbaum Associates, Mahwah (1995)
15. Sanna, L.J., Carter, S.E., Small, E.M.: The road not taken: counterfactual thinking over time. In: Press, O.U. (ed.) Judgments Over Time: The Interplay of Thoughts, Feelings, and Behaviors, New York, NY, pp. 163–181 (2006)
16. Snyder, T.D., de Brey, C., Dillow, S.A.: Digest of Education Statistics 2014, Washington, DC (2016)
17. Goldberg, L.R.: A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models (1999). http://projects.ori.org/lrg/PDFs_papers/Abroad-bandwidthinventory.pdf
18. Grab the Games: The Deed [Computer Software] (2015)
19. Beepa Pty Ltd.: Fraps [Computer Software] (2013)
20. Tabachnick, B.G., Fidell, L.S.: Using Multivariate Statistics (1996)