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Effects of Human Interactions with Computers on Ethical Decisions

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Abstract

This study examined the differences between digital (tablet or computer) and non-digital (paper) human interactions on decision making. Students were presented with the same ethical prompt to activate an abstract mindset for each condition. Students considered the same ethical dilemma for each digital or non-digital condition, then made a decision.

Keywords: cognitive information processing, digital technology, ethical decisions

Effects of Human Interactions with Computers on Ethical Decisions

Schools seek the promise of educational technology to solve problems and to explore new ways of learning and applying knowledge as evident by IT budgets of $12B for K-12 and $11B for higher education (EdTech, 2017). Consequently, administrators struggle with decisions given the dizzying amount of technology choices.

Prior studies investigated digital technology and effects on cognitive processing and learning (Gausby, 2015; Rosenwald, 2014) and differences related to quality and quantity of processing (Cytowic, 2015; Nicolas, Rowlands, & Clark, 2011). Humans develop new habits, such as multitasking and cognitive shortcuts, while interacting with digital devices (Fisher, Goodu, & Keil, 2015; Gazzley & Rosen, 2016; Kaspersky, 2015; Liu, 2005;). Accordingly, researchers are uncovering the cognitive consequences associated with divided attention, memory, and learning (Cytowic, 2015; Liu, 2005; Ophir, Nass, & Wagner, 2009; Wolf & Barzillai, 2009). Studies conducted by Eshet-Alkalai & Chajut (2009) showed a sharp decline in creativity and critical thinking over a 5-year span in younger participants compared to adults related to digital experience. The identification and understanding of interacting factors involving computer technology and learning remain confusing, complex, and limited in empirical evidence (Underwood & Farrington-Flint, 2015).

Statement of the Problem

There is a scarcity in understanding of how digital environments activate abstract thought and decisions. Therefore, an increase of experimental methods to investigate relationships between digital media, cognitive processing, and learning will provide better data for educational leaders and further extend understanding of interacting factors.

Theoretical Framework

The theoretical framework for this study relates to **cognitive information processing and Human Computer Interaction (HCI).** Specifically, this draws upon **Construal-Level Theory (CLT)**, concrete versus abstract thought, to examine the relationship between cognitive processing and digital technologies. CLT postulates that individuals cognitively construe psychologically near objects in terms of concrete features and psychologically distant objects as abstract (Trope & Liberman, 2010; Trope, Liberman, & Wakslak, 2007). According to Trope & Liberman (2010), as psychological distance increases, cognitive representations become more abstract. Likewise, as the level of abstraction increases, so does psychological distance.

Presented with an ethical prompt in digital or non-digital environments, differences in decisions will relate to CLT and psychological distance. Therefore, this research seeks to advance understanding about the relationship between cognitive processing and digital media.

Significance of the Study

Emerging educational technologies and the increasing ubiquitous nature of digital devices present new questions about the impact on learning. Yet, there is a lack of research using experimental design methods to inform educational leaders. This study sought to investigate the activation of abstract thought and ethical decisions in digital and non-digital conditions. Moreover, the ethical prompt in this study extends to developing issues of artificial intelligence.

Literature Review

Demands for educational technology remains steady but poses new decisions about promising innovations at all levels of education. In addition, both K-12 and higher education share two common technology priorities: digital content and mobility (Edtech, 2017). There is a growing array of choices confronting educators with challenging decisions related to the

influence on learning outcomes despite gaps in rigorous research (Zheng, Warschauer, Lin, & Chang, 2016).

Research involving digital technology yields inconsistent results in part because of complex relationships. A recent meta-analysis of studies about school laptop programs does not show a significant positive effect for reading achievement (Zheng et al., 2016). However, a few studies included in the meta-analysis identified some specific factors that influence results, such as disadvantaged students, development, and laptops at home.

Experiments conducted by Kaufman and Flanagan (2016) examined how digital technologies triggered either lower (concrete) or higher level (abstract) mindsets when given a prompt for making a decision about a product's attributes while challenged by "information overload." According to Kaufman and Flanagan, there were differences in construal level of thought for the same information based on either paper or digital platforms. Results showed that digital versions triggered greater concrete mindsets compared to paper versions. A series of additional experiments revealed that those exposed to paper readings also showed greater abstract thinking compared to multiple digital platforms as evidenced by inference and comprehension scores (Kaufman & Flanagan, 2016).

Conflicting research results and fears about technology, especially those related to artificial intelligence (AI), present new questions for researchers and educators. Emerging AI programs embedded in daily tools and across context present new decisions and ethical dilemmas. Although Kaufman and Flanagan (2016) showed that digital technologies trigger mindsets, cognitive construal level theory has not been examined in relation to ethical decisions involving technology.

Liviatan, Trope, and Liberman (2008) investigated the relationship of similarity and dissimilarity with mental judgments about others. Conditions that included similarity with others triggered low-level construal representations compared to conditions of dissimilarity which showed high-level representations.

Norman, Tjomsland, and Huegel (2016) contend that digital communications influence interpersonal distance, and that construal level theory explains the underlying psychological mechanisms. Their work draws upon studies conducted by Trope, Liberman, and Wakslak (2007) that identified four dimensions of psychological distance: temporal, spatial, social, and hypothetical.

According to construal level theory, psychological distance is a subjective experience and considered egocentric (i.e., Henderson, Fujita, Trope, & Liberman, 2006; Liberman & Forster, 2009; Liviatan et al., 2008). Researchers are beginning to uncover relationships and influences between digital devices and construal level theory. Drawing upon the framework of construal level theory, experiments examined the influence of digital communications, including social media environments, and psychological distance (Norman et al., 2016). Another approach by Kaufman and Flanagan (2016) applied construal level theory to investigate relationships with reading comprehension and attention to details between paper and digital platforms. Findings point to the paradox involved in human computer interaction (HCI): digital platforms offer affordances by directing attention to concrete details for some cases while showing deficits for abstract or higher level construal thinking in other conditions.

Studies by Trope et al. (2007) demonstrated an association between levels of construal and representations of psychological distance (i.e., time, space, social). Moreover, Trope and Liberman (2010) put forth the following assertions about the association between cognitive

construal levels and psychological distance: a) that the various distances are cognitively related; b) that various psychological distances influence are influenced by level of cognitive construal, and c) that they similarly affect prediction, preference, and consumer behavior.

The results from this study were compared to a previous experiment by the author (Niccoli, 2017) that examined ethical decisions based on mode (paper or tablet) and format (one or two pages). Each group condition was exposed to a prompt that included a drone explosion and text that listed statistics for the number of drone strikes, civilians killed, children killed, and members of al Qaeda. After reading the prompt, students responded to the question, "*Should the U.S. continue using drones at the same rate?"* for all conditions (Appendix C).

Results for the drone decision showed a significant difference and medium effect (r = .40) between page formats (one or two pages) for tablet, but not for paper (p = 0.86). Most significant differences were responses between page formats within the tablet group ($p < 0001$). There was a change in decision choice between the single and two-page format, indicating an influence of format involving tablets that was not evident for paper mode.

Accordingly, this study extends current research in construal level theory by investigating the effects on decisions between digital and paper versions in relation to psychological distance (CLT).

General Method

The primary goal for this study is to investigate the effects on decisions using digital technologies when prompted with an ethical dilemma compared to a non-digital condition in relation to psychological distance. Specifically, this research addresses two overarching questions*:*

(1) Do digital technologies influence different cognitive construal levels on ethical decisions compared to non-digital conditions?

(2) Does the type of digital device influence cognitive construal levels on ethical decisions?

Sample Participants and Procedure

Existing class groups of adult military leadership students with approximately 10 years of service and with exposure to ethics training for each of the experimental conditions. Students were randomly assigned to read either a digital or non-digital ethical dilemma and make a decision after reading the ethical prompt. A control group consisting of new Officer Candidate School students provided data for comparison with experimental groups (*N = 179*).

Data collection comprised two experiments: Experiment 1 exposed students to one of three conditions, paper, digital tablets, or online prompts. Participants were presented with a two-page prompt that displayed an image on the first page and text on the second. Data collection was conducted while students attended a campus course for the paper and tablet conditions and for the online condition, data was collected from students enrolled in the online version of the same course. For the online condition, students were presented with the same digital version as the tablet condition. The paper and tablet participants responded to the question on a separate paper. The online students read an electronic version of the text and responded to the same question as the paper and tablet participants but used a survey tool.

Experiment 2 exposed tablet participants to a single-page format of the image and text to compare with the two-page group to determine if there was a difference based on page format.

Hypotheses

The following hypotheses were tested to determine the effects of digital technologies on cognitive construal levels (concrete vs. abstract) and ethical decisions:

H_0: There is no difference in military students' ethical decisions of an ethical dilemma based on digital or non-digital technology.

H_1: Military students presented with a paper prompt of an ethical dilemma will make significantly different decisions compared to those using digital technology.

H_2: Military students presented with a digital prompt of an ethical dilemma will make significantly different decisions based the type of digital technology device.

H_3: Military students presented with a prompt of an ethical dilemma using a tablet device will make significantly different decisions based on page format (one or two pages).

Design: Quasi-Experimental

Convenient groups of military students were randomly assigned to read an ethical prompt about autonomous vehicles and to make a decision while using either paper or digital technology (*N = 179*). Each version included the same text and image, but differed in condition, either paper, digital tablet, or online mode (Appendix A).

To elicit abstract thinking related to construal level theory, participants were presented with a prompt describing ethical dilemmas involving autonomous vehicles. For Experiment 1, students read the same ethical prompt regardless of mode (paper, online, tablet) and were presented with a two-page format for all conditions. Experiment 2 exposed students to a single page format condition with tablets to determine differences between page formats (one or two-pages).

The ethical dilemma prompt described choices that engineers consider when programing algorithms for autonomous vehicles. For example, anticipating a life-threatening scenario, engineers will need to program a decision making process about harming humans. Autonomous vehicles may need to "decide" who will survive, either passenger(s) or pedestrian(s).

After reading the ethical prompt, students responded to the question, "*Would you buy an autonomous (driverless) vehicle*?" Students recorded their responses, the dependent variable, on a separate sheet of paper for all conditions except for the online platform (Appendix B). Responses for the online condition was collected using an available survey tool for the course.

Variables

The factorial between-subject design for this study comprises three independent variables related to mode (paper, digital tablet, and online) and one related to format (one or two pages). The dependent variable for all conditions was the decision, either Yes or No (Appendix B).

Data Analysis

The researcher computed chi-square tests of independence using SPSS® to test each hypothesis.

H_1: Military students presented with a paper prompt of an ethical dilemma will make significantly different decisions compared to those using digital technology.

H_2: Military students presented with a digital prompt of an ethical dilemma will make significantly different decisions based the type of digital technology device.

H_3: Military students presented with a prompt of an ethical dilemma using a tablet device will make significantly different decisions based on page format (one or two pages).

Experiment 1

Hypothesis 1 presented participants with an ethical prompt using either paper or digital technology (online or tablet) to determine differences in decisions based on mode in responding to the question, "*Would you buy an autonomous (driverless) vehicle*?" Hypothesis 2 sought to determine differences based on the type of digital technology (online vs. tablet).

Method

A control group consisting of new Officer Candidates were exposed to a two-page paper format to compare with the experimental groups (*N = 49*). Officer Candidates responded to the question as the experimental groups, "*Would you buy an autonomous (driverless) vehicle?*" yielding the results shown in Table 1.

Table 1

Control (N =49)

Yes	**No**
7 (14%)	42 (86%)

Experiment 1 comprised of a two-page format for paper, tablet, and online modes. Participants for each experimental condition were presented with the same prompt and recorded responses on separate paper except for the online condition (Table 2). Students for the online course responded to the same question as the other conditions, but used an online survey tool.

Table 2

Two-Page Format (N = 95)

Paper 2 Pages	**Tablet 2 Pages**	**Online 2 Pages**
24	40	31

Results

Experiment 1 tested the first two hypotheses that compared decisions between paper, tablet, and online conditions using a two-page format:

H_1: Military students presented with a paper prompt of an ethical dilemma will make significantly different decisions compared to those using digital technology.

H_2: Military students presented with a digital prompt of an ethical dilemma will make significantly different decisions based the type of digital technology device.

Table 3 displays the response distribution for each group while Table 4 shows the frequency percentages.

Table 3

Mode results *(N =95)*

Decision	Paper 2 Pages	Tablet 2 Pages	Online 2 Pages
Yes	4	8	9
No	20	32	22

Table 4

Mode frequencies *(N =95)*

Decision	Paper 2 Pages	Tablet 2 Pages	Online 2 Pages
Yes	17%	20%	29%
No	83%	80%	71%

Chi-square test of independence ($p = 0.05$) was performed to test H_1 and determine if there were significant differences between paper and digital modes (two-page format).

Results did not show a statistically significant difference in results between paper or digital groups: X_2 (2 N = 95), p = 0.567.

H_2 sought to determine differences between digital devices, online or tablet for a two-page format. Similarly, chi-test results (p = .25) did not indicate a significant difference between online and tablet participants exposed to the two-page format. For both hypotheses and conditions in Experiment 1, there were no statistically significant differences in responses. Rather, the results support the null hypothesis**.**

Experiment 2

Considering the results of the two-page format, a second experiment for tablets was conducted to compare with a single page format. Participants were exposed to the same image and prompt as Experiment 1, but using a single page. Experiment 2 tested the following hypothesis:

H_3: Military students presented with a prompt of an ethical dilemma using a tablet device will make significantly different decisions based on page format (one or two pages).

Method

A second tablet group (N = *35*) was presented with a single page format. Participants read the same prompt (single page) and responded on a separate paper similar to the two-page format given for Experiment 1.

Results

Chi-square test results (p = 0.31) comparing single and two-page formats using tablets did not show a significant difference in decisions. See tables 4 and 5 for the distribution and frequencies of decision results.

Table 5

Tablet format results *(N = 75)*

Decision	Tablet 1 Pages	Tablet 2 Pages
Yes	4	8
No	31	32

Table 6

Tablet format frequencies (*N = 75)*

Decision	Tablet 1 Page	Tablet 2 Pages
Yes	11%	20%
No	88%	80%

Results for Experiment 2 did not show differences based on page format for tablets, thereby supporting the null hypothesis.

Discussion

This study examined the nexus of cognitive construal levels with ethical decisions between digital and non-digital conditions. Although there were no statistically significant differences in decision making between modes (paper, tablet, or online) or between tablet formats (singe or two-pages), nevertheless, the results support construal level theory. The ethical prompt presented a thought experiment involving autonomous vehicles that was expected to trigger abstract thinking. After considering the ethical dilemma, participants decided whether they would purchase an autonomous vehicle. The question posed a personal decision that increased the likelihood of a concrete (low level) construal thinking process, consequently

reducing psychological distance. The results suggest that the personal decision triggered a concrete mental model that took precedence over the abstract concept related to the ethical dilemma prompt. The question, "*Would you buy an autonomous (driverless) vehicle?*" reduced psychological distance, subsequently eliciting concrete mindsets and decisions.

The results from these experiments contrast with a previous study by this author (Niccoli, 2017) involving the use of combat drones. Similar to this study, the drone experiments compared ethical prompts and decisions about the use of combat drones using paper and tablet modes. Likewise, both the autonomous vehicle and drone dilemmas involved deaths of innocent people. Furthermore, the sample for the previous drone study was comparable to the autonomous vehicle study. Chi-square tests of independence for mode (paper, tablet) and page format (single, two pages) showed significant differences in decisions for the drone experiments while there were no significant differences for autonomous vehicle decisions.[1]

Using construal level theory to explain the results of both studies, it is possible that the ethical prompt used in the drone experiments triggered high-level construal mental models. Perhaps the question also triggered psychological distance when participants considered the drone decision, "*Should the U.S. continue using drones at the same rate?*" (Appendix C). The drone experiment presented an ethical decision for using combat drones that increased spatial and social dimensions of psychological distance. This contrasts with the autonomous vehicle experiments that presented a prompt evoking a personal decision, thereby reducing psychological distance and moderating the influence of the abstract ethical prompt.

[1] Niccoli, A. (2017). The effects of reading mode and format on decision making. AERA Online Paper Repository, http://www.aera.net/Publications/Online-Paper-Repository/AERA-Online-Paper-Repository/Owner/993559

As displayed in Table 7, the frequencies of "Yes" decision are higher for the drone tablet decisions (far distance) compared to the autonomous vehicle (AV) decisions (close distance) for both single-page and two-page formats. Moreover, the results of the autonomous vehicle experiments yielded greater frequencies of "No" decisions across all modes (paper or digital) and for both formats (single page or two pages).

Table 7

AV vs. Drone frequencies

Yes Decision	**Tablet 1 Page**	**Tablet 2 Pages**	**Paper 2 Pages**	
Drone	32%	72%	57%	(*N =84*)
AV	11%	20%	16%	(*N =99*)

Note: Drone prompt is "far" psychological distance; AV is "close" distance.

The drone experiment uncovered significant differences between single page and two-page tablet formats that contrasted with results for the autonomous vehicle experiments. Differences in construal levels of thought, triggered by social and spatial dimensions, subsequently increased psychological distance in support of CLT (i.e., Liberman & Forster, 2009; Trope & Liberman, 2010). Regardless of format or device, there was no statistically significant difference for ethical decisions characterized as psychologically close in distance compared to significant differences for psychologically distant decisions while using digital devices.

Limitations

The sample consisted of military adults with about 10 years of service who were exposed to ethical lectures prior to making the decision. It is possible that prior exposure to ethical

decision making scenarios influenced the responses, nevertheless, the results of the experimental group (paper) did not differ from the control group. Although the sample size is small, the results of statistical chi-tests suggest that a larger sample may not yield significant differences.

Implications for Educators

This study further extends the body of knowledge by investigating the relationships between CLT, digital devices, and cognitive processes. Examining the effects of digital devices on learning is both complex and dynamic. There are multiple dimensions related to human-computer interactions encompassing device characteristics, cognitive tasks, psychological qualities, and social factors that influence learning and performance. Moreover, educators need better understanding of influential factors and interacting effects as digital technology integrates across environments and domains.

Given the disruptive nature and adoption of digital devices for education and learning while at campus and home, it is important for educators to understand how technology influences cognitive processing and learning. Taking into account the exposure to digital devices and online environments, research lags behind technological advances that continuously change our learning landscapes.

In particular, there is a dearth of empirical evidence to inform educators about the optimal conditions for integrating digital technology (i.e., content design, purpose, student level, medium). Through continuous and current studies, educators will deepen understanding of learning and performance while under the influence of digital environments.

Recommendations

Considering the gap between the use of digital technology and supporting research, the field will benefit from additional studies that examine different prompts and decisions across

digital environments. Because of the pervasive adoption of digital devices in education, and the subtle influences on cognitive processing, educators are poised to lead research activities that uncover relationships between human interactions with computers and learning. Studies that contribute empirical evidence involving multiple devices can inform educators with making evidence-based decisions from an array of choices.

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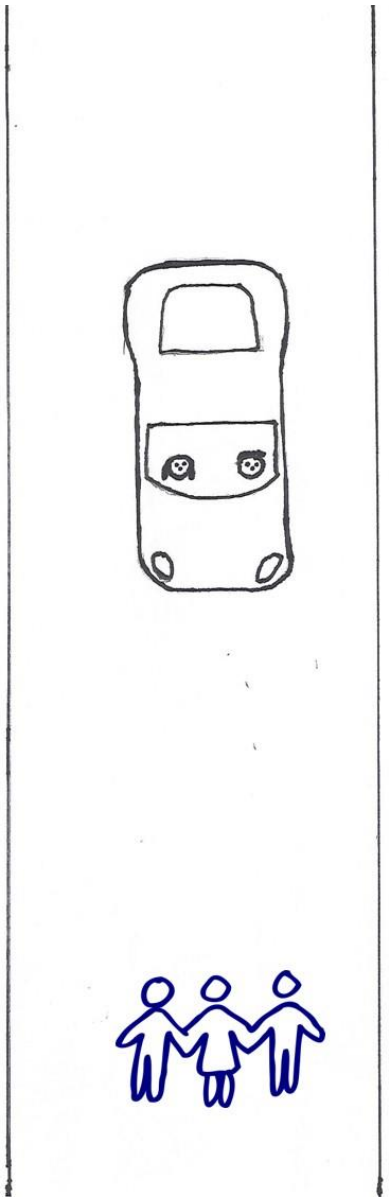
Appendix A

Autonomous Vehicle (Driverless)



Appendix A (continued)

Imagine you are riding in an autonomous, self-driving car that is moving at high speed. Unexpectedly, you notice pedestrians walking directly ahead in the path of the car. The autonomous car must be programed to make a choice to determine who will survive and who will die: either the passengers in the autonomous vehicle or pedestrians will die.

Computer engineers can program autonomous vehicles for one of three options:

1. Always stay. In such a situation, the car would continue on its path, kill the pedestrian(s) on the main road, but you as the passenger will be unharmed.

2. Always swerve. In such a situation, the car would swerve quickly, diverting the car onto the side road where it will kill you as the passenger, but the pedestrian(s) on the main road will be unharmed.

3. Random. In such a situation, the car would be programmed to randomly choose to either stay or swerve.

Should decisions consider the age of pedestrians or the driver, whether they are young or old?

What about if a pedestrian or passenger is disabled?

Adapted from Bonnefon, J-F.,Shariff, A., & Rahwan, I. (2016). The social dilemma of autonomous vehicles. *Science*, *352(*6293), 1573-1576. doi: 10.1126/science.aaf2654. Retrieved from http://science.sciencemag.org/content/352/6293/1573.full

Appendix B

Decision

Would you buy an autonomous (driverless) vehicle?

YES_____ **NO_____**

Appendix C

Single Page Explosion

(Paper and Tablet)

https://www.dvidshub.net/

The Bureau of Investigative Journalism estimates the following cumulative statistics about US drone strikes (as of 1 September 2015):

- Total strikes: 421
- Total killed: 2,476 - 3,989
- Civilians killed: 423 - 965
- Children killed: 172 - 207
- Injured: 1,158 - 1,738
- Strikes under the Bush Administration: 51
- Strikes under the Obama Administration: 370
- 84 of the 2,379 dead have been identified as members of al Qaeda

It is stated in a Bureau of Investigative Journalism (BIJ) report that of all the drone attack victims since 2004, more than 76% of the dead fall in the legal grey zone, 22% are confirmed civilians (included 5% minors) and only the remaining 1.5% are high-profile targets.

Appendix C (continued)

Decision Sheet

(All Conditions)

Should the U.S. continue using drones at the same rate?

Yes_____ No_____