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Moral incompetency under time constraint

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ABSTRACT

This research seeks to understand how time constraint can escalate mental efforts and change the outcome of moral judgment when we face moral dilemma. Using functional near-infrared spectroscopy (fNIRS), hemodynamic responses in the dorsolateral prefrontal cortex (DLPFC) were recorded while subjects were deliberating over choices under the situations of business moral dilemma. Bilateral increase of oxyhemoglobin values on DLPFC was observed from subjects who made moral choices under time constraint. The results of suggest that severe time constraint can overburden the activities of moral brain and elevate decision stress, possibly leading to moral incompetency.

1. Introduction

"Wisely and slow; they stumble that run fast."

(by William Shakespeare)

"Quicker and faster," today's business culture values work speed. Stock brokers have to make buy or sell decisions in seconds. Deadlines are given in hours and days instead of months and years in many workplaces. The pace of life is accelerating. At the same time, evidence of systematic breaches in ethics and moral incompetence in enterprises is escalating. Human decision-making, as evidenced by previous studies, is less than perfect (Simon, 1982; Woodside, 2012), particularly under time constraint. Among many decisions that we face, moral dilemmas can be the toughest of the decisions we make. A moral dilemma is a situation in which we feel a moral obligation to do one thing (a moral choice: MC hereafter) (Lurie & Albin, 2007) but see that doing another thing can be personally more profitable (a profit choice: PC hereafter). MC and PC are often mutually exclusive options.

In this paper, we investigate the effect of time constraint on the brain's response during moral dilemma. Applying the neuroscience method called functional near infrared spectroscopy (fNIRS) will allow us to uncover the underlying process mechanisms of the human brain. Neuromarketing has seen a fast growth during the past few years. Neuromarketing applies the neuroscience method to solve problems related to business and marketing. While the survey methodology based on participants' self-reports often fails to provide insights beyond the realm of self-awareness, neuromarketing aims at discovering unconscious processes and influences that underlie consumer choice. Human respondents often provide answers that they believe are socially acceptable (Fisher, 1993), so there is a threat to validity. Adopting a neuromarketing approach can help to identify hidden process mechanisms without explicit verbal questioning, as brain responses can reveal the naturally occurring thought processes as they happen. Previous empirical studies have identified the brain's empathetic responses to prosocial brands (Lee, 2016) and green marketing messages (Lee et al., 2014) as increased theta band brain wave activities in the frontal brain.

One of the recent developments in neuromarketing research is increased affordability. Functional near-infrared spectroscopy (fNIRS) is a neuroimaging technique that measures cortical blood flow. fNIRS has gained interest as a potential alternative to fMRI (functional magnetic resonance imaging). NIRS is non-invasive, portable, and has a cost advantage. The transparency of biological tissue to light in the near-infrared wavelengths makes near-infrared spectroscopy (NIRS) possible. NIRS is an optical neuroimaging tool that can non-invasively monitor brain activity function by observing the changes in the concentration of oxygenated hemoglobin (HbO_2) in the blood stream (Strangman, Franceschini, & Boas, 2003). Its application to academic research in is being widely explored in the field of psychology and human neuroscience, particularly for the frontal brain functions, such as cognitive and mental workload (Ferreri et al., 2014; Fishburn, Norr Megan, Medvedev Andrei, & Vaidya Chandan, 2014; Ozawa, Matsuda, & Hiraki, 2014).

2. Literature review

2.1. Effects of time constraint on decision stress

Temporal construal theory provides a theoretical framework that

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explains how the lack of temporal distance can have a negative influence on moral reasoning (Trope & Liberman, 2010). The theory proposes that the same event or object can be represented at multiple levels of abstraction such that individuals can construe mental representations of their decisions from different levels of psychological distances (e.g., social, temporal, and spatial distance). People with psychologically distant mind-sets tend to think more abstractly and consider larger implications of their decisions, while people with psychologically close mindsets tend to think more concretely (Trope & Liberman, 2010) by focusing on concrete, imminent outcomes. Temporal distance has been related to moral decision-making (Eyal, Liberman, & Trope, 2008) and to strengthening moral principles when viewed from a temporal distance. Indeed, moral transgressions are evaluated more harshly when people imagine that the transgressions occur in the distant future, rather than the near future (Agerström & Björklund, 2013).

Conceptual models in the literature of moral decision-making have delineated the rational and intuitive foundations of moral decision processes (Ferrell & Gresham, 1985; Rest, 1986; Trevino, 1986; Jones, 1991), including the role of time constraints (Trevino, 1986). Time constraint can be particularly detrimental to decisions that require a long-term perspective, as time constraint reduces the opportunities for deep, reflective thinking. Ethical decisions, such as thinking about the future ethical ramifications of a choice, require abstract thinking with a long-term perspective (Agerström, Björklund, & Carlsson, 2012).

Suter and Hertwig (2011) suggested that time constraint can change the course of moral judgment such that, when moral decisions are forced upon individuals, the time that is available can affect the individuals' reliance on gut feelings. Prospect theory predicts that, when a loss is inevitable, the fear of loss may loom larger when the time of loss is near, rather than far, a prediction that has been confirmed in behavioral finance (Benartzi & Thaler, 1995). Similarly, Chu, Im, and Lee (2014) note that regulating emotions in crisis situations is necessary for business professionals to make optimal business decisions.

Drawing on the review of relevant literature, we predict that a utilitarian moral choice which is a strenuous task that can cause high levels of stress. If a moral agent is given pressing deadlines for an already difficult challenge, she or he might struggle more than usual to see the larger implications of his or her choice. Agents' levels of stress and emotional well-being may differ substantially with the factor of time availability; thus, the ability to adopt temporal distance allows moral agents time to reconcile competing values.

Moral distress has been defined as painful feelings that occur because of situational constraints against doing what one perceives as morally correct (Jameton, 1984). A business-related moral dilemma presents a decision task with conflicting values and responsibilities that can distress an agent's conscience (Wilkinson, 1987). Specifically, an agent faces a conflict between his or her moral responsibility and professional responsibility when the two responsibilities are mutually exclusive.

Suter and Hertwig (2011) suggest that the time that is available for a decision can alter the course of the decision in the direction of increasing the reliance on gut feelings. With increasing time constraint, business managers' stress can increase (Edland & Svenson, 1993) and moral competency can diminish. Coupled with a crisis mentality, the level of moral distress will intensify when a manager faces short deadlines. The relationships between the proposed constructs are depicted in Fig. 1.

2.2. Developing research hypotheses

We develop research hypotheses about the brain's responses to time constraint when an agent must find a solution to a business-related moral dilemma. Previous studies have found that short-term perspective can facilitate immoral choices (Agerström & Björklund, 2013; Eyal et al., 2008).

The folk logic in the domain of morality is that self-control and self-regulation is sufficient for preventing moral failure of individuals. However, recent studies are discovering self-control and willpower is a limited resource, which can be depleted by certain strenuous situational factors (Baumeister & Vohs, 2007). Time pressure is known to overload the human mind during information processing (Hahn, Lawson, & Lee, 1992). Time constraint deprives the opportunity to think reflectively and often change the outcome of moral judgment.

According to dual processing models, the effect of time constraint on decision quality will be pronounced in utilitarian decisions. A previous study found that increased cognitive load negatively affects utilitarian moral judgment (Greene, Morelli, Lowenberg, Nystrom, & Cohen, 2008). Woodside, de Villiers, and Marshall (2016) suggests that MBA graduates who were professionally trained in management also fumble under crisis. Individuals' mental efforts and distress is a crucial component in trying to understand where people are overloaded and eventually become incompetent moral agents. The role of DLPFC is crucial because its activation is known to correlate with cognitive load and moral efforts. Individuals' mental efforts and distress is a crucial component in trying to understand where people are overloaded (Jaeggi et al., 2007) and eventually become mentally incompetent to make the right choice. Therefore, we present the following hypothesis.

Hypothesis 1. Time constraint under the situation of moral dilemma increases the probability to make immoral as opposed to moral choices compared to the situation where time constraint is not present (a). Physiologically, increased concentrations of oxygenated hemoglobins (HbO_2 hereafter) in the DLPFC area will be observed during moral as opposed to immoral choices under high time constraint (b).

Neuroscience studies have measured the effect of sensori-neural stimulation on hemodynamic responses and found that auditory stimulation can elevate HbO_2 in the blood flow to selected regions of the brain. In particular, the decrease of HbO_2 in the dorsal prefrontal cerebral volume may signal efficient and successful cognitive function brain (Kotilahti et al., 2010; Sakatani, Chen, Lichty, Zuo, & Wang, 1999). For example, children who are good at computers show decreased (increased) HbO_2 while they play computer games where as older adults feel frustration when they have to play computer game. The frontal brain is of particular interest for the tasks of moral decision-making that are specific to the business context because of its important role in cognitive control and conflict resolution (Greene, Nystrom, Engell, Darley, & Cohen, 2004; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001). fMRI studies have suggested that a neural mechanism that underlies moral decision-,making may integrate processes involving multiple regions, including the frontal regions of the brain (Greene et al., 2001; Greene et al., 2004; Lieberman, Gaunt, Gilbert, & Trope, 2002; Moll & de Oliveira-Souza, 2007; Shenhav & Greene, 2014). Greene et al. (2001, 2004) found that the dorsolateral prefrontal cortex (DLPFC) area is activated when individuals make difficult personal moral judgments, as resolving competing values requires decision-makers to execute cognitive control in the DLPFC (MacDonald, Cohen, Stenger, & Carter, 2000). Since oxygen consumption increases with the activation of affected areas of the brain, an fNIRS study found higher HbO_2 concentrations in the lateral prefrontal cortex during incongruent trials of the Stroop task (Schroeter, Zysset, Kupka, Kruggel, & von Cramon, 2002). Another fNIRS study suggested that the higher HbO_2 concentrations in the lateral prefrontal cortex are due to interferences and conflicts perceived during the Stroop task (León-Carrion et al., 2008). The area of brain activity that modulates moral decisions is the DLPFC, so it has a vital function in implementing cognitive control under conditions of a severe moral conflict.

Taken together, these studies suggest that the DLPFC may not require an extra supply of oxygen for tasks it can perform without difficulty, but it demands a higher level of oxygen supply for difficult and stressful tasks. Therefore, we hypothesize that, under time constraints, an agent perceives difficulty and stress, which will be identified by high concentrations of HbO_2 in the DLPFC. Given a short decision deadline, agents experience elevated levels of HbO_2.

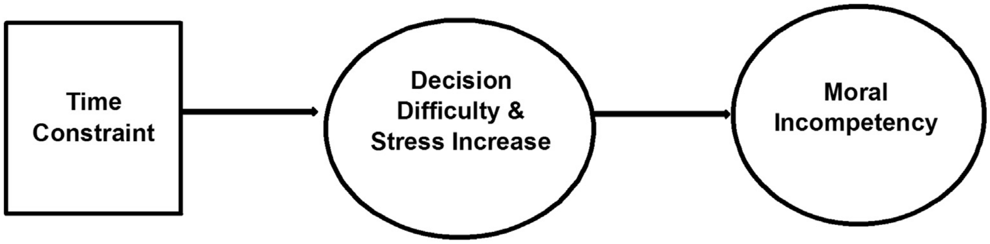

Fig. 1. Conceptual model.

Hypothesis 2. Time constraint during moral decision making will increase decision stress, which is measured behaviorally as the perceived task difficulty (a), and physiologically as increased HbO_2 in the DLPFC area (b).

3. Study 1: behavioral investigation

Study 1 is a behavioral survey-experiment involving 144 business students. Participants were given two undesirable alternatives: advocating the profit principle, and advocating the moral principle. The design of experiment was a 2 (decision time constraint: short deadline vs. long deadline) × 2 (type of dilemma scenarios) between-subject design. The purpose of this experiment was to ascertain the effect of time availability on perceptions of decision difficulty and stress. The two examples of business-related moral dilemmas appear in Table 1.

The business dilemma scenarios used for our study borrowed the basic structure of a prototypical example of a moral dilemma: the trolley and the footbridge problem (Thomson, 1985). In the trolley and footbridge dilemma, the decision is whether to pull a lever to stop the current course of a trolley that is rushing toward five people on the track. If the driver pulls the lever, the trolley will go off the track onto a footbridge and kill one passerby who was not on the track. If the driver does nothing, he can save the passerby's life, but the five people on the track will be killed. When facing this kind of moral dilemma, the decision-maker will always be conflicted, no matter what choice s/he makes. Neither is a good choice (Sinnott-Armstrong, 2008).

The business dilemma scenarios we created for this study presented two mutually exclusive options, the MC and PC options. Two additional scenarios were developed to include situations like a stock broker's use of insider information and an organizational psychologist's disclosure of a company secret to a close friend.

The short deadlines for each scenario were given in ranges of days while long deadlines were given in ranges of months. After reading a scenario, the participants evaluated the case regarding their perceptions of the deadline, the decision difficulty, and stress. We also checked for the realism of the scenarios. The questionnaire items used in a self-report survey appear in Table 2.

Using ANOVA, we first checked for manipulation. The results of ANOVA, as shown in Table 2, revealed a significant difference in perceived temporal distance between the short and long deadline conditions ($M_{short} = 1.67$, $M_{long} = 5.65$, $F = 392.1$, $p < 0.001$), as participants perceived higher levels of decision difficulty and stress when the deadline was short versus when it was long ($M_{short} = 4.80$, $M_{long} = 4.03$, $F = 4.82$, $p = 0.003$). Participants reported a greater level of concern about later feeling regret over their decisions under the short deadline than they did with the long deadline ($M_{short} = 4.07$, $M_{long} = 3.61$, $F = 3.34$, $p = 0.013$). They also felt that it was more difficult to choose the moral option when under time constraint ($M_{short} = 3.94$, $M_{long} = 3.01$, $F = 10.05$, $p = 0.002$).

The participants' perception of the scenarios' realism did not differ significantly with the change in the time available for the decision ($p > 0.15$). Fig. 2, which depicts the results of the behavioral study, shows that, under the rushed deadline condition, the participants perceived escalated decision difficulty and stress.

4. Neural investigation

Neural investigation of the research model is conducted with a two-part fNIRS experiment. The first part of fNIRS study measures the DLPFC activity under time constraint while the agents solve a business-related moral dilemma by making either a moral or immoral choice. The second part of fNIRS study manipulates the time constraint factor and measures brain activity of selective moral agents while they make moral choices in solving dilemma.

4.1. Experimental paradigm

The experimental paradigm is presented in Fig. 3. The first part of experiment used the first scenario in Table 1. The case was presented as the high time constraint condition only. The fNIRS experiment for each participant was individually scheduled in advance, as each participant was brought individually to a laboratory. After arriving at the lab, the participant provided a written consent and was seated in a comfortable chair while the experimenter applied the fNIRS probe-sets on the forehead overlaying the prefrontal cortex. The fNIRS experiment was

Table 1
Examples of business-related moral dilemma scenarios.

Case	Time	Scenarios
Corporate tax case	You have to make this decision in: − 3 days − 6 months	Your parents own a small company. Because of a recent economic recession, the family company's financial situation is not good. As a business undergraduate, you have learned about corporate tax in accounting management. You realize that you can save money if you purchase your car or other personal items under the name of a company. Option MC. If you purchase a car under your personal ownership, there will be additional taxes and insurance fees, which will financially burden your parents. Option PC. If you purchase a car under the company's ownership, you can save tax and insurance money, which will be helpful under your parents' current circumstances.
Drug research case	You have to make this decision in: − 5 days − 9 months	You are the R & D manager at an international pharmaceutical company. Your research team recently developed a vaccine that can protect people from the virus, but it contains a bad viral sprain that increases the vaccine's risk to a 10% chance of severe side effects from the viral infection. Option MC. If you report the actual defect rate (10%) to the FDA, the new vaccine will not be approved, and your company could go bankrupt. Option PC. If you report the defect rate of 5% to the FDA, the drug will be approved and your company will generate trillions in income for the next five years, but some users may experience side effects.

Table 2
Behavioral survey results (Study 1).

	Items	Condition	Mean (SEM)	F (Sig.)
Time constraint	The time constraint for this decision was __.	Short (deadline)	5.67 (0.13)	392.10 (0.000**)
	(1 = very low; 7 = very high)	Long (deadline)	1.65 (0.14)	
Decision stress	The level of mental stress I would feel if I have to make this decision is ______.	Short	4.80 (0.24)	4.82 (0.003**)
	(1 = very low; 7 = very high)	Long	4.03 (0.26)	
	There is a possibility that I will regret my choice.	Short	4.07 (0.19)	6.34 (0.013*)
	(1 = strongly disagree; 7 = strongly agree)	Long	3.61 (0.21)	
	The time constraint made it difficult for me to make the right choice.	Short	3.94 (0.20)	10.05 (0.002**)
	(1 = strongly disagree; 7 = strongly agree)	Long	3.01 (0.21)	
Scenario realism	It was difficult to put myself in the position of a decision-maker in this case.	Short	3.01 (0.17)	2.33 (0.107)
	(1 = strongly disagree; 7 = strongly agree)	Long	3.46 (0.18)	

Note. Numbers indicate the mean, and parentheses indicate the standard error of the mean.
* $p < 0.001$.
** $p < 0.01$.
*** $p < 0.05$.

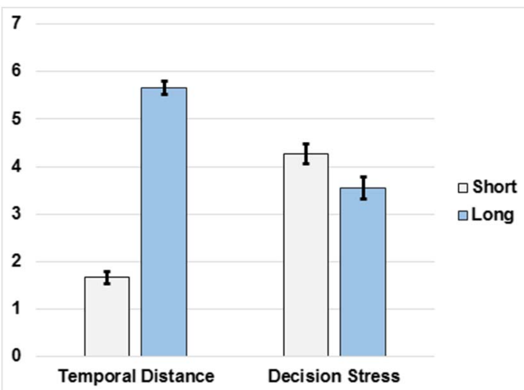

Fig. 2. Time constraint and decision stress (Study 1).

implemented in a sound-attenuated, dimly lit room. The experimental stimulus was presented on a computer monitor located 30 cm from where the participant sat.

The experimental paradigm was executed in the sequence shown in Fig. 3. After the participant read each business-related moral dilemma scenario, a baseline brain activity was measured for 3 s, after which participants were given 10 s to decide between the MC and the PC options (i.e., the moral decision phase). The participant indicated his or her the final choice by pressing a button on a response pad. NIRS signals during the decision phase were processed and analyzed for testing the research hypothesis.

4.2. fNIRS measurement and analysis

The transparency of biological tissue to light in the near-infrared wavelengths makes near-infrared spectroscopy (NIRS) possible. The incident near-infrared light from a transmitting optode (source) is scattered through the tissues, and the reflected light is detected by a receiving optode (detector). The amount of the light that a tissue absorbs depends on the source light's wave length. The oxygenation status is determined by the affected neurovascular system's absorption of the light. The loss of intensity that is due to the absorption of the photons can be measured in units of optical density (Zaramella et al., 2001). The changes in HbO_2 can be calculated according to the modified Beer-Lambert law (Kocsis, Herman, & Eke, 2006) using two wave lengths of near-infrared light—in our case, 780 and 850 nm. We measured the participants' hemodynamic responses using a 12-channel wireless fNIRS system that was custom-built with sampling rates of 8–10 Hz. The system consists of three light sources and five detectors (a 3 × 7 grid). The fNIRS probe was attached to each subject's forehead; the detectors of the lowest line were set along the Fp1 and Fp2 electrode line according to the international 10/20 system.

The fNIRS device we used is a continuous wave (CW) spectroscopy system in which brain tissues absorb the light at a constant amplitude. Even a minimum level of light can be applied to tissue since tissue is highly sensitive to light sources. We applied polydimethylsiloxane (PMDS) evenly on the fNIRS probe-set in order to optimize the signal-to-noise ratio during the recording. In addition, the light sources are activated constantly over a short period of time, with each source comprised of two LEDs (wavelengths of 780 and 850 nm). The output of the optical probe connected to a 10-bit AD converter can be saved by converting the data from values of the let-go current to the voltage values (Kim, Lee, Koh, & Kim, 2011). A source-detector distance of 3 cm provides a penetration depth of 1.5 cm into the brain tissue. The changes in HbO_2 concentration were displayed on the host PC in real time during data collection.

Using custom-written MATLAB codes, we applied the modified Beer-Lambert law to pre-process the raw light intensity values (Kocsis et al., 2006). We also undertook a signal-preprocessing step to remove any instrumental noise and measurement errors that are irrelevant to the brain activities. Instrumental noise, such as ambient light intensities surrounding the environment, were subtracted from the fNIRS measurement values. Source-detector channels that either had a low signal-to-noise ratio or showed severe head and body movement artifacts were omitted from the final analysis. Because of our interest in the right and left areas of the DLPFC, we analyzed optical measurements from channels 4 and 10. The fNIRS we used provided reliable signals of HbO_2, but the wavelength configuration—particularly the 780 nm light source—did not provide signal changes in the concentrations of deoxygenated hemoglobin that were as reliable as those of HbO_2. Hence, our analysis focused on the HbO_2 concentrations from the fNIRS data.

4.3. fNIRS part 1: the DLPFC activations of moral vs. immoral choices

We recruited a total of eighteen subjects (mean age = 23 years) to participate in fNIRS measurement study. The procedure was approved by the institutional review board (IRB) of the authors' university. We recruited senior undergraduate students majoring in business administration and master-level business students with average of business education over one year. Among eighteen participants, ten (eight) subjects made moral (immoral) choices.

We compared the differences in prefrontal brain activations particularly in DLPFC area, between moral and immoral choices. Repeated-measures ANOVA tests were applied to the HbO_2 signal acquired during the 10-second moral decision phase. Fig. 4 presents the grand-average time course plot of HbO_2 concentrations on the left DLPFC (channel 10) and right DLPFC (channel 4). The repeated-measures ANOVA on bilateral DLPFC HbO_2 values revealed statistically different effects of moral choice ($F (1, 16) = 8.35$, $p = 0.01$). There was a significantly higher HbO_2 concentration level under the high as opposed to low time

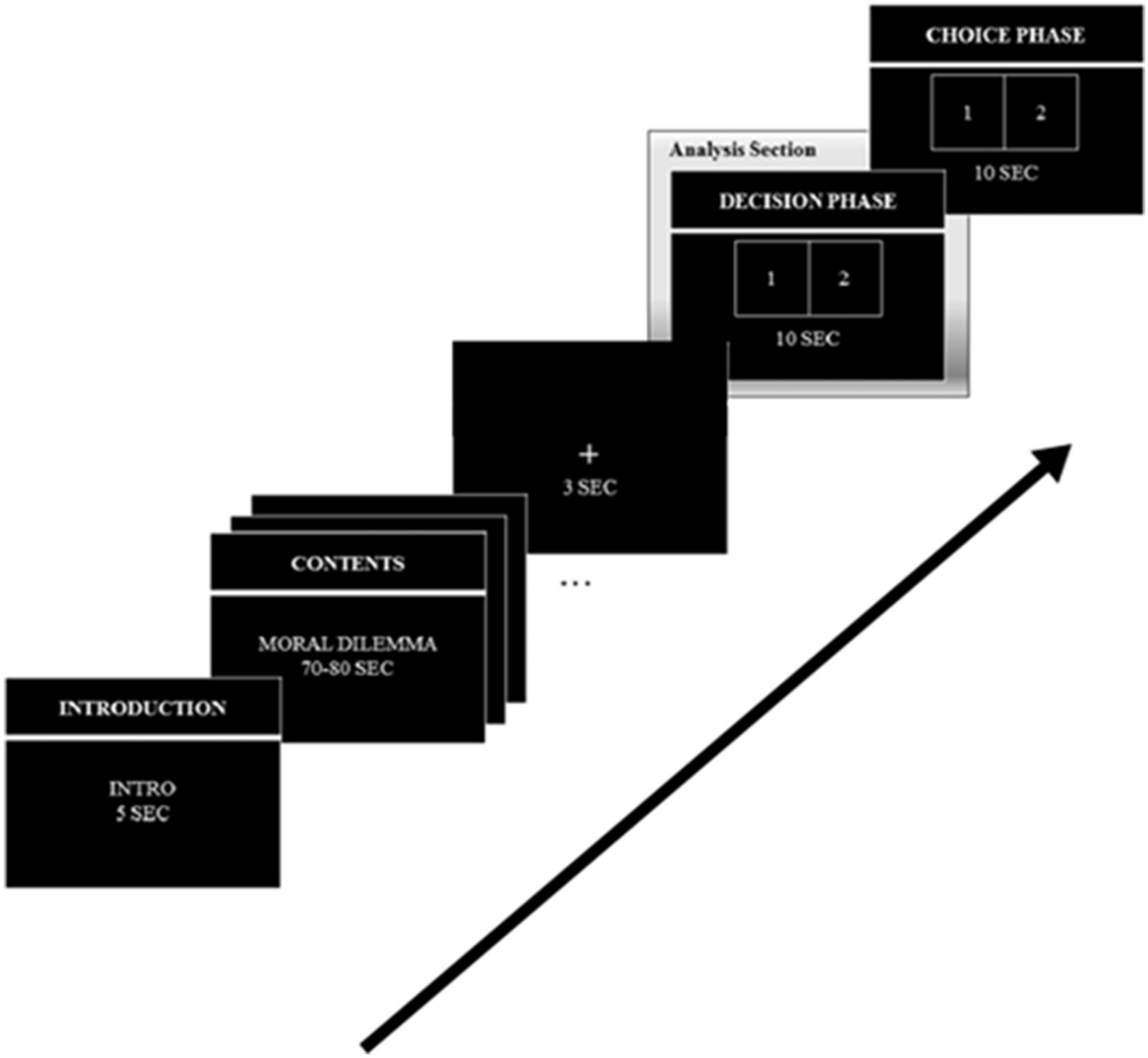

Fig. 3. Nirs experiment paradigm.

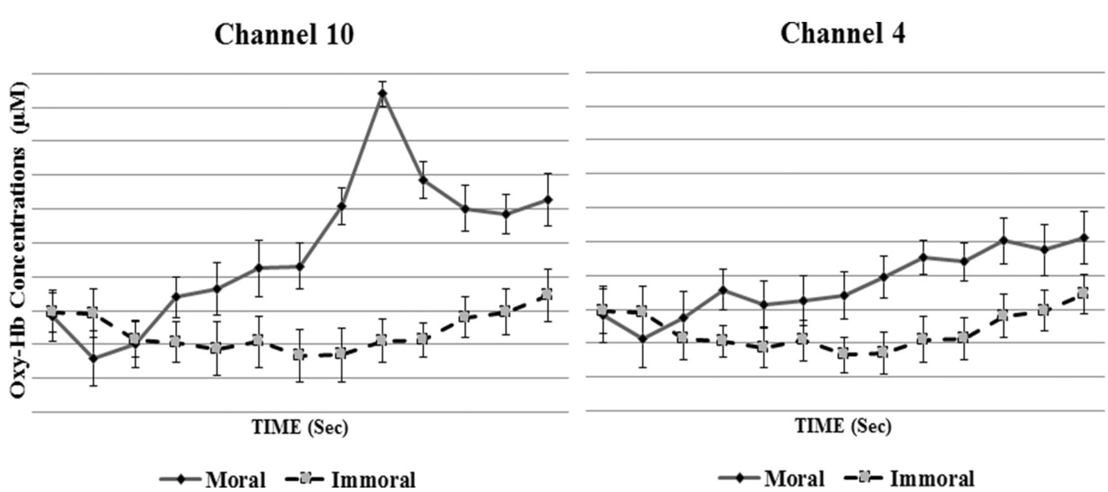

Fig. 4. DLPFC activations during moral and immoral choices.

constraint conditions. The strength of the moral choice effect, computed by the eta-squared effect size ($\eta^2 = 0.34$), was greater than the effect of laterality ($\eta^2 = 02$).

4.4. fNIRS part 2: the DLPFC activations of high vs. low time constraint conditions

We used a 2 (scenarios: corporate tax and drug research) × 2 (decision time: short vs. long) within-subject design. The two scenarios presented in Table 1 were used in the fNIRS study. The scenario and deadline combinations were counterbalanced so half the subjects were given a short (long) deadline for the corporate tax (the drug research) case while the other half were given a stimuli with a counterbalanced scenario and deadline combination.

Twenty students (mean age = 22.5 years) were recruited to participate in the fNIRS study. The procedure was approved by the institutional review board (IRB) of the authors' university. The recruited participants were senior undergraduate students majoring in business administration with average of business education of at least one year. We removed three left-handed participants from the subject pool, as handedness is known to cause directional differences in hemispheric response patterns (Lake & Bryden, 1976). We also rejected the data from three subjects because of a severe head-movement artifact and an inability to focus on the task. The final sample consisted of sixteen healthy participants, who made moral choices in both the corporate tax and the drug research cases. Repeated-measures ANOVA tests were applied to the HbO_2 signal acquired during the 10-second moral decision phase. Fig. 5presents the grand-average time course plot of HbO_2 concentrations on the left DLPFC (channel 10) and right DLPFC (channel 2). The repeated-measures ANOVA on bilateral DLPFC HbO_2 values revealed statistically different effects of deadline length (Wilk's $\lambda = 0.681$, $F(1,14) = 6.573$, $p = 0.023$, $\eta^2 = 0.32$) after the Greenhouse-Geisser correction. As shown in Fig. 5, there was a significantly higher HbO_2 concentration level under the high time constraint condition than there was under the low constraint condition ($M_{\text{high}} = 0.54$ vs. $M_{\text{low}} = 0.38$ using normalized values). The effect of scenario counterbalancing on the HbO_2 concentration was insignificant ($p > 0.3$), as was the effect of laterality—left or right hemispheres ($p > 0.5$)—on HbO_2. The strength of the time constraint effect, computed by the eta-squared effect size ($\eta^2 = 0.32$), was greater than the effect of scenario counterbalancing ($\eta^2 = 0.067$), the effect of laterality ($\eta^2 = 0.025$), and the effect of a specific channel within each hemisphere ($\eta^2 = 0.10$).

5. Study 3: moral choice experiment

In study 3, we conducted a behavioral experiment involving 43 future business managers. Participants were recruited from the pool of business undergraduate and graduate students. The design of experiment was a 2 (time constraint: severe vs. no constraint) between-subject design. The purpose of this experiment was to investigate how severe time constraint can increase the probability of making immoral choices. We used the business-related moral dilemmas are presented in Table 1, but changed the degree of time constraint. Under the time constraint condition, subjects were told that they had to make a choice by tomorrow while a decision can be made within one year for the no constraint condition. The survey experiment demanded no personally identifiable information in order to avoid possible social desirability effect.

The results of moral choice of 43 subjects are as follows. Under the time constraint condition, 4 out of 21 subjects (18%) made moral choices. However, when the decision time frame was sufficient, 11 subjects chose morally (50%). Chi-square results showed a marginally significant association between time constraint ($p = 0.056$).

In summary, we found that time constraint under the situation of moral dilemma increased the probability to make immoral as opposed to moral choices compared to the situation where time constraint was not present, thereby supporting H1a. Physiologically, increased HbO_2 in the DLPFC area was observed during a moral choice as opposed to during an immoral choice under high time constraint (H1b supported). Also, we found that severe time constraint during moral decision-making increased decision stress, evidenced behaviorally as the perceived task difficulty and stress (H2a supported) and physiologically as increased HbO_2 in the DLPFC area (H2b supported).

6. Discussion and conclusion

Sustainability and ethical consumption has become an essential topic in business research (Chelladurai, 2016) (Mazanov & Woolf, 2017).

(Di Benedetto, 2017; Han & Childs, 2016; Kim, Taylor, Kim, & Lee, 2015; Lee & Jackson, 2010; Min Kong & Ko, 2017; Park, Ko, & Kim, 2010; Park, Lee, & Koo, 2017). Business-related moral dilemmas that deal with the trade-off between economic and moral principles (Michael, 2013) are often among the hardest decisions for a business manager to make, as he or she must choose between financial and moral principles. In an organizational context, a business manager can develop "temporal myopia,"—that is, weighing the immediate loss of profits too heavily and closing the eyes to the future by not thinking of the larger implications of a decision (Benartzi & Thaler, 1995).

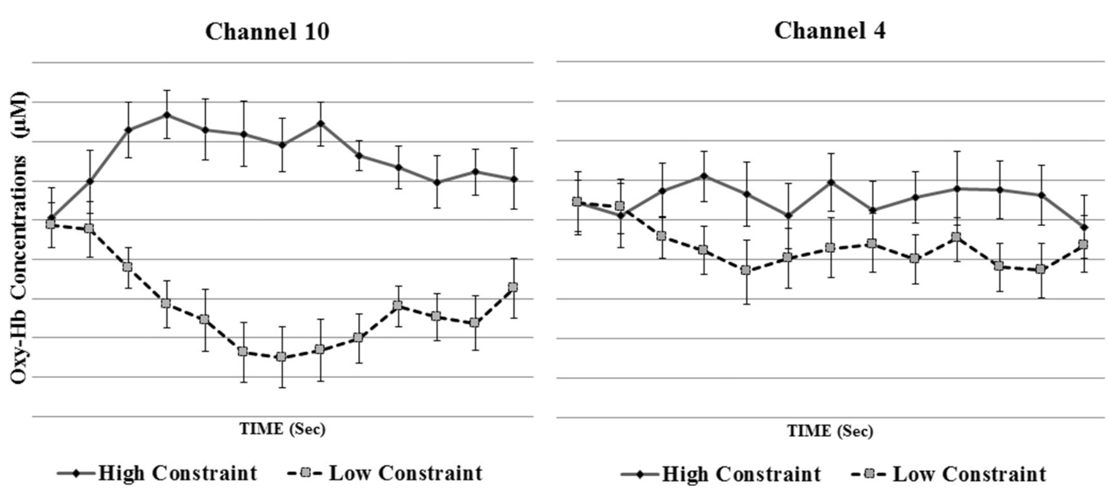

Fig. 5. DLPFC activations under high and low time constraint conditions.

The key role of time representation in moral decision process is often downplayed in past research because the ideal rational person should to find two statements which contain the same immoral content to be logically the same. Ideal rationality suggests that representation of different time frames should not change the outcome of decisions of moral agents. The result of current research suggests that time does matter because human decisions are adaptive. Finding right representation of time is an indispensable part of moral problem solving.

Depending on the time available for the decision, the same decision can generate varying levels of stress. Having sufficient decision time can reduce managers' stress levels, as time provides the opportunity to consider the decision from the temporal perspective. With fNIRS, we focused on the dorsolateral prefrontal cortex (DLPFC), an area that has been linked to cognitive and moral judgment (Glenn, Raine, Schug, Young, & Hauser, 2009; Greene et al., 2004; Tassy, Oullier, Cermolacce, & Wicker, 2009). Diminished levels of HbO_2 concentrations in the brain's center for cognitive control, DLPFC, under the no constraint condition suggest diminished moral stress. On the other hand, severe time constraint before an important moral decision escalates stress, as identified by the elevated levels of HbO_2 in the bilateral DLPFC activities, and can seriously handicap one's moral judgment. In reality, however, business managers have little control over when crises occur or how long a deadline they can have, so practical advice when a deadline nears and the pressure is on, would be asking oneself how one would make the decision – if this decision needs not to be made in haste but slowly and wisely. Asking this question and imagining the response can improve moral competency of business managers.

The current research contributes to the interdisciplinary literatures of business ethics, neuromarketing, and cognitive neuroscience. The present study contributes in two ways. First, the study applies the methodology of neuroscience to the research of business ethics. Discoveries about the underlying neural mechanisms of ethical decision-making can add to the literature a new perspective beyond the conventional research paradigm (Plassmann, Venkatraman, Huettel, & Yoon, 2015; Venkatraman, Clithero, Fitzsimons, & Huettel, 2012). Second, we identify neural correlates that can be linked to moral stress caused by time constraint. Previously, decreased HbO_2 concentrations in the DLPFC have been associated with better memory performance (Ferreri et al., 2014; Ferreri, Aucouturier, Muthalib, Bigand, & Bugaiska, 2013) but not with moral competency. High oxygenation responses are often observed in neurosensory studies when subjects are overloaded, by being given a level of stimulation that is greater than their normal level of activity. When a task is difficult and requires extra mental efforts, our brains demand extra oxygen for the activities in the DLPFC region. The previous findings are similar to our results since we found that under high time constraint, individuals can have heightened oxygenation and gamma-range EEG activities (Oathes et al., 2008). It is important for marketing researchers to better pinpoint exactly where individuals are overloaded, thereby resulting in breaches in ethics and moral incompetence in enterprises. Business educators must guide future business leaders to make moral judgments in such a way that they feel justified instead of stressed by their moral choices. The emotional stress that an agent can experience when he or she chooses a moral option is significant, and thus, there is a need for more future research into the emotional well-being of business agents who have to make hard choices.

The limitations of the study are lack of external validity which are also found in most experimental research including the use of imagined scenarios for the student sample. Using scenarios to understand moral decision processes has a long history in previous business ethics research (Paolillo & Vitell, 2002; Singhapakdi, Vitell, & Kraft, 1996; Weber, 1992). Although neuroscience research suggests that humans have the ability to envision future events and simulate experiences via mental time-travelling (Viard et al., 2011), future research is needed to ascertain the time constraint effect in a more realistic setting.

In conclusion, the current research helps to guide future business leaders to make the right choice when they have to made decisions under severe time constraint. Having a long-term perspective can proactively help us to steer the right path, and to feel dignified instead of stressed while doing the right thing. We must find time to foster our moral competency.

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