# Conscientiousness and effort-related cardiac activity in response to piece-rate cash incentives

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**Abstract:**

Although conscientiousness predicts many aspects of motivation, from delay of gratification to higher achievement, its relationship to responses to monetary incentives is surprisingly inconsistent. Several studies have found null or negative relationships between conscientiousness and behavioral performance in piece-rate, pay-for-performance tasks, in which people earn money for each unit of work completed. In the present study, we examined the role of conscientiousness in effort-related cardiac activity and behavioral performance during a pay-for-performance task. People worked on a self-paced, piece-rate cognitive task in which they earned 1 cent or 5 cents, manipulated within-person, for each correct response. Conscientiousness predicted greater physiological effort (i.e., shorter pre-ejection period [PEP] reactivity) as incentives increased but had no effect on behavioral performance. The findings suggest that conscientiousness is significantly related to effort for piece-rate tasks, and they reinforce a core idea in motivational intensity theory: effort, performance, and persistence are distinct outcomes that often diverge, so drawing conclusions about effort from performance can be complex.

**Keywords:** Conscientiousness | Effort | Motivation | Incentives | Impedance cardiography | Pre-ejection period

**Article:**

## Introduction

People high and low in conscientiousness—the tendency to be organized, diligent, thorough, and self-controlled (Lee and Ashton 2012)—end up leading very different lives (Soldz and Vaillant 1999). People high in conscientiousness have higher levels of academic achievement (Noftle and Robins 2007; Poropat 2009), better workplace performance in a wide range of jobs (Barrick and Mount 1991), and higher occupational attainment (Roberts et al. 2007).

Conscientiousness involves motivational aspects of personality, such as working hard, delaying gratification, and focusing on achievement, as well as dependability aspects of personality, such as being organized, responsible, and conventional (DeYoung et al. 2007; Digman 1990). Because of its volitional character and role in real-world achievement, conscientiousness's motivational dynamics have been widely studied (Judge and Ilies 2002).

Money is obviously an important real-world incentive (Jenkins et al. 1998), but research on how conscientious people respond to monetary incentives is surprisingly inconsistent. A common paradigm uses piece-rate, pay-for-performance tasks, such as a task that offers a fixed payment per unit of output. Because people can adjust their effort to achieve their desired level of payment, personality traits associated with reward responsiveness and goal striving should play a role in how people respond to piece-rate reward structures (Stewart 1996).

To date, research on piece-rate rewards suggests that conscientious people might be less responsive to monetary incentives. In a workplace study, employees higher in conscientiousness had more new sales regardless of whether the incentives favored gaining new sales or retaining existing customers (Stewart 1996). In a set of recent lab experiments (Fulmer and Walker 2015), participants worked on tasks (creating words from anagrams or translating symbols into text) under a flat-rate condition (a fixed lump-sum payment for a time period of work) and a piece-rate condition (a fixed amount per item completed correctly). Compared to the fixed condition, the piece-rate reward condition seemed to impair motivation—measured as behavioral task performance—among highly conscientious participants. Conscientiousness was related to less responsiveness to the piece-rate task (significant in one study but not in the other), which suggests that people high in conscientiousness were less motivated by the piece-rate incentives. The researchers suggested that conscientious people might focus more on task mastery and energy regulation instead of maximizing the amount of money they earn.

The negative findings are surprising because of conscientiousness's widespread role in real-world motivation and achievement. We suggest that Brehm's motivational intensity theory (Brehm and Self 1989; Brehm et al. 1983) offers a fruitful point of view on this problem. Motivational intensity theory is a prominent model of how people engage and withdraw effort (Gendolla et al. 2012; Richter et al. 2016). Although the theory can inform a wide range of motivational issues, two aspects of it are especially relevant to the present problem.

First, the theory addresses effort in response to piece-rate tasks. When a task has this kind of incentive structure—often called a "self-paced" or "unfixed difficulty" structure (Wright 2008; Wright et al. 2002)—the intensity of motivation should be a function of the value of the incentive for the person. This prediction has been so widely supported that piece-rate, unfixed tasks are often used to identify other factors (e.g., personality traits or clinical symptoms) that affect motivation by affecting the perceived value of an incentive (e.g., Silvia et al. 2013, 2014). We thus would expect to see differences in effort in response to differences in incentive value. If conscientious people do indeed expend less effort, as previous research based on performance suggests, then the model would suggest that the money at stake holds less value for them.

Second, research in motivational intensity theory highlights the crucial differences between *effort, performance*, and *persistence*. High levels of effort—the intensity of motivation mobilized to confront a challenge—need not translate linearly into high levels of performance (how well people actually do on the challenge) or persistence (how long people spend on it). Effort and performance are commonly linked (i.e., trying harder improves performance), but they are often unrelated or even inversely related, such as when people compensate for fatigue (Hockey 2013; Wright and Stewart 2012) or low ability (Hockey 1997; Kukla 1972; Wright and Dill 1993) by expending more effort. Performance is obviously an important outcome in motivation research, but there are good reasons to avoid drawing conclusions about effort from performance.

The motivational intensity literature thus has a long tradition of using psychophysiological outcomes to assess effort-related changes in the body, particularly markers of how the sympathetic branch of the autonomic nervous system affects the cardiovascular system (Wright and Kirby 2001). The most common physiological measures focus on *contractility*, the force of the heart's left ventricular contraction as it ejects blood into the aorta. Contractility is a function of beta-adrenergic sympathetic influences on the heart (Mohrman and Heller 2013), so it can illuminate how the sympathetic branch of the autonomic nervous system modulates cardiac activity in response to motivational challenges. Contractility can be assessed non-invasively using impedance cardiography methods. The cardiac pre-ejection period (PEP; Kelsey 2012), the time in milliseconds between the onset of the ventricular depolarization and the opening of the aortic valve, was our primary measure of beta-adrenergic influence on the heart. PEP is a reliable measure of sympathetically-mediated inotropy (Burns et al. 1992), and a large body of work on motivation provides evidence for its validity for research on effort (Gendolla et al. 2012; Richter and Gendolla 2009; Richter et al. 2016). Additionally, the RZ interval, also called the initial systolic time interval (ISTI; Meijer et al. 2008; van Lien et al. 2013), was used as a secondary sympathetic measure along with PEP (Silvia et al. 2014a, b, 2016).

In short, it is conceivable that conscientious people value cash rewards less and thus expend less effort to attain them, as suggested by recent studies of performance (Fulmer and Walker 2015). But if we recognize the difference between effort and performance, it would appear that the hypothesis has not yet been fully tested. Decrements in performance might not reflect reduced effort, given that effort is only one of many factors that affect how well people perform on a task. Because conscientiousness has a widespread role in real-world achievement, and because money is commonly used to signal that a goal is important and worth one's time and attention, it seems just as likely that conscientious people do expend more effort for piece-rate tasks. Conscientious people are goal oriented, and based on motivational intensity theory, incentives signal that a goal is relatively more important. In an organizational context, for example, offering money as an incentive for signing new clients signals that the people in a position to give the incentive see that goal as relatively more important than other goals (e.g., satisfying and retaining existing clients). As a result, conscientious people should be sensitive to increases in goal importance (indicated by incentive value) and exert more effort as incentives increase. Such an effect, however, has not been captured in previous studies because effort doesn't necessarily translate into performance.

**The present experiment**

In the present experiment, we examined how conscientiousness moderates the effects of piece-rate cash incentives. People worked on a cognitive task in which they made simple judgments and could work at their own pace. Each correct response earned them a fixed amount of money (i.e., 1 cent or 5 cents), paid in cash, so the reward structure was piece-rate. People completed two blocks of the task—one block paid only 1 cent for each correct response, but the other block paid 5 cents. We examined how varying levels of conscientiousness related to changes in effort as incentives changed. Because each participant completed both blocks, which were counterbalanced in order, changes in effort-intensity across the two conditions can be attributed to changes in incentive value.

Personality traits were assessed with standard self-report scales. Cardiac autonomic activity was measured throughout, so the experiment provides both physiological markers of effort obtained via impedance cardiography (the cardiac PEP and RZ interval) as well as behavioral measures of task performance (how many correct responses people accumulated). By measuring both effort (assessed via effort-related cardiac activity) and performance (the number of correct responses), the experiment can illuminate underlying effort processes that aren't apparent in behavioral performance alone.

If people higher in conscientiousness use incentives as cues to a goal's importance, then we would expect an interaction between conscientiousness and incentives: more conscientious people should exert increasing effort as the incentive value increases. In contrast, if people higher in conscientiousness value rewards less, as suggested in past work on behavioral performance (Fulmer and Walker 2015), then the interaction should reflect decreasing effort among relatively more conscientious people as the incentive value increases. Our predictions are primarily for psychophysiological markers of effort mobilization. We did not have predictions for behavioral performance on the cognitive task. Because performance doesn't necessarily move in parallel with physiological markers of effort, it was measured and analyzed on an exploratory basis.

## Method

### Participants

Fifty undergraduates (33 women, 17 men) took part and received credit toward a research participation option. The sample was relatively young ($M = 19.38$, $SD = 2.02$, range from 18 to 28) and racially and ethnically diverse. According to self-report, the sample was predominantly African American (34%), European American (48%), and Hispanic or Latino/a (20%). (Participants could select more than one option or decline to select any.) Seven additional participants had taken part but were dropped, primarily because of equipment or software failure (3), limited English fluency (1), and confusion about the parity task and their resulting at-chance performance (3). Our sample size target was to collect data for a full semester, with a minimum of 40 participants, based on sample sizes from our past research using similar methods (e.g., Silvia et al. 2013). The data were not screened or analyzed before all data were collected.

The participants were randomly assigned to one of four between-group conditions involving the counterbalanced incentive order (1-cent first or 5-cent first) and item-set order. Incentive value (1 cent or 5 cents per correct response) was manipulated within-person.

Procedure and materials

All participants provided informed consent, and the project was approved and monitored by the Institutional Review Board. Participants came into the lab individually and were run by a same-gender experimenter. The experimenter explained that the purpose of the study was to examine how the heart reacts to cognitive tasks requiring quick decision-making. The experimenter placed electrodes on the participant and allowed the signals to stabilize. Afterward, there was a baseline period in which participants completed a series of innocuous questionnaires that took around 8 min. Values during the last 6 min served as the baseline values. This sort of "plain vanilla" baseline holds constant irrelevant features shared by the baseline and task (e.g., sitting upright, reading from a monitor, and responding with a keyboard). The surveys and tasks were collected using MediaLab and DirectRT via a high-speed keyboard with 1 ms timing accuracy.

**Assessment of conscientiousness.** The HEXACO Personality Inventory (HEXACO-100; Lee and Ashton 2004) was used to measure conscientiousness. The HEXACO-100 is a 100-item measure that assesses 6 personality dimensions: Honesty-Humility, Emotionality (Neuroticism), Extraversion, Agreeableness, Conscientiousness, and Openness to Experience. Most of the HEXACO traits broadly resemble the Big Five traits; the most notable difference is the distinction between Agreeableness and Honesty-Humility (Lee and Ashton 2012). As before, conscientiousness was the most relevant trait, but all the traits were included to control for their overlap. The items are rated on a 5-point scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, and 5 = *strongly agree*). Conscientiousness scores had good internal consistency ($\alpha = .83$).

**Parity task.** A parity task was used for the piece-rate cognitive task. This task has been effective in previous effort studies (Chatelain and Gendolla 2015; Harper et al. 2016; Silvia et al. 2014b, in press). Participants were asked to decide whether two numbers had the same parity or not. The number flanked a word that appeared in the center of the screen: sample items are 7 BOAT 9 and 8 BENCH 5. The words were 12 commonplace nouns (e.g., *boat, bench*, and *chair*). Participants pressed a yellow button if the numbers had the same parity (i.e., both are even or both are odd) and a blue button if the numbers had different parities (i.e., one is even and one is odd). The parity task was an unfixed difficulty task (Wright et al. 2002); the stimulus remained on the screen until the participant responded, so participants could work at their own pace. The software did not provide any feedback during the parity task, largely because errors are so rare (e.g., participants on average answered correctly 99% of the trials) and it is easy for participants to monitor whether a response was correct.

Participants completed two blocks of the parity task. For one block, participants were instructed that they would receive 1 cent for each correct item. For the other block, participants were instructed that they would receive 5 cents for each correct item. Each block was 3 min long and participants could work at their own pace, yielding a piece-rate incentive structure. The task incentive manipulation was within-person, so all participants completed both blocks (1 cent block and 5 cent block). Participants were told that the goal was to get as many correct as possible, and they were informed by the software and the experimenter about which monetary incentive they were receiving for each block.

There were two between-group counterbalancing factors. First, the incentive level was counterbalanced: participants were randomly assigned to receive either the 1-cent block or 5-cent block first. Counterbalancing the order of the incentives allows us to separate change due to incentive value from change due to time itself (such as fatigue, habituation, or practice). Second, to prevent item-familiarity effects, two sets of parity items, consisting of different neutral words and digits, were created. People completed both sets but in different orders, thus separating the effects of familiarity and practice from other factors. The two sets were manipulated orthogonally to incentive level, thus resulting in 4 between-group conditions.

After completing the parity task, participants completed the following self-report items: "In your opinion, how easy or hard was this task?" (1 = *very easy*, 7 = *very hard*), and "In your opinion, how well did you do on the parity task?" (1 = *very poorly*, 7 = *very well*). Afterwards, participants learned more about the background and purpose of the study and received cash in the amount that they earned from the parity task.

Physiological Assessment

Cardiovascular activity was assessed using impedance cardiography methods. The signals were acquired using a Mindware Bionex hardware system (Mindware, Gahanna, OH) and processed and analyzed with Mindware's Biolab 3.1 and IMP 3.1 software programs. An ECG signal was collected with a modified lead 2 placement of spot electrodes (one placed on the right collarbone, one placed on the left lowest rib, and one placed on the right lowest rib). Using a standard tetrapolar placement, Z0 and dz/dt signals were acquired via 2 receiving spot electrodes placed on the front of the participant's body (one placed on the left collarbone at the level of the suprasternal notch and one placed below the sternum at the level of the xiphoid) and 2 sending electrodes placed on the back (one placed 1.5 inches above and another placed 1.5 inches below the receiving electrodes). The ICG and ECG signals were sampled at 1000 Hz and were filtered offline (ECG and dZ/dt: .5 to 45 Hz; $Z_0$: 10 Hz low cutoff; 60 Hz notch).

Ensemble averages (Kelsey et al. 1998) were formed by carving the baseline and task periods into 60-s epochs. PEP, our primary measure of contractility, was calculated as the time (in ms) between the ECG Q-point (the onset of ventricular depolarization) and the dZ/dt B-point (the opening of the aortic valve and onset of left ventricular ejection). Q was estimated as the lowest value in the 35 ms window prior to the R peak (Berntson et al. 2004). B was estimated with the Lozano et al. (2007) slope/intercept method (i.e., RB = RZ × .55 + 4 ms). These points were identified automatically by the software (IMP 3.1.1) and corrected in only a small number of cases.

RZ, an additional measure of contractility, was calculated as the time (in ms) between the ECG R point (the point of peak electrical activity) and the dZ/dt Z point (the dZ/dt peak and point of maximal diameter of the aortic arch; van Eijnatten et al. 2014). The RZ interval, also known as the initial systolic time interval (ISTI; Meijer et al. 2008), is appearing more frequently as a measure of beta-adrenergically mediated cardiac contractility. RZ is defined by the salient R and Z points, the peaks of their respective waveforms, instead of the sometimes subtle Q and B points (van Lien et al. 2013). Good evidence for RZ as a measure of contractility has been found in exercise, pharmacology, and clinical paradigms (Smorenberg et al. 2013; van der Meer et al. 1999; van Eijnatten et al. 2014; Wilde et al. 1981). RZ has worked at least as well as PEP in several recent effort experiments (Silvia et al. 2014a, b, 2016), and researchers have called for more research into its usefulness (van Lien et al. 2013).

Finally, heart rate, expressed as the interbeat interval (IBI, in ms), was assessed and analyzed as well. We did not have specific hypotheses regarding IBI. Because it is affected by both branches of the autonomic nervous system, IBI usually does not track sympathetic markers like PEP (Berntson et al. 1993; Richter 2012), but it was measured and reported for comprehensiveness and because of the long-standing interest in heart rate responses to incentives (see Fowles 1983; Richter 2012).

## Results

### Descriptive statistics, preliminary analyses, and analytic approach

Table 1 displays the descriptive statistics for PEP, RZ, and IBI. Scores were calculated for three periods: the *baseline* (consisting of an average of the 6 60-s periods), the *1-cent block* (consisting of an average of 3 60-s task periods), and the *5-cent block* (consisting of an average of 3 60-s task periods). The baseline values were stable and highly reliable (Cronbach's $\alpha = .988$, .987, and .996 for PEP, RZ, and IBI, respectively). The sample showed broad variability in HEXACO conscientiousness scores ($M = 3.50$, $SD = .64$, range from 2.25 to 4.63).[1]

**Table 1.** Baseline and task physiological values

| **Outcome** | **Baseline** | | **1 Cent** | | **5 Cents** | |
|---|---|---|---|---|---|---|
| | ***M*** | ***SD*** | ***M*** | ***SD*** | ***M*** | ***SD*** |
| PEP | 124.22 | 10.21 | 122.19 | 10.83 | 121.15 | 10.68 |
| RZ | 165.80 | 17.79 | 161.85 | 18.44 | 159.86 | 19.17 |
| IBI | 798.46 | 136.61 | 792.93 | 136.99 | 793.98 | 130.01 |

$n = 50$

*PEP* pre-ejection period, *RZ* R to Z interval, *IBI* interbeat interval, *SD* standard deviation

For the two between-group counterbalancing factors, preliminary mixed-model ANOVAs found no significant main effects of incentive order ($F < 1$) or item-set order ($F < 1$). Likewise, neither of these counterbalancing factors significantly interacted with each other ($F < 1$) or with the within-person period factor (effects ranged from $F < 1$ to $F(2, 88) = 2.04$, $p = .136$). As a result, these counterbalancing factors were omitted from subsequent analysis. Likewise, preliminary analyses estimated both linear and quadratic effects of time period. In all cases, only the linear effects were significant, so subsequent models included only the linear effect of time.

[1] As noted, all 6 HEXACO traits were included in the analyses to control for the minor overlap between them. The other 5 traits showed the expected range of variability: honesty-humility ($M = 3.41$, $SD = .55$), emotionality ($M = 3.50$, $SD = .60$), extraversion ($M = 3.68$, $SD = .51$), agreeableness ($M = 3.04$, $SD = .48$), and openness to experience ($M = 3.33$, $SD = .47$).

Because our central hypotheses involved continuous between-person variables (e.g., conscientiousness) and a within-person factor (time period: baseline, 1 cent, and 5 cent), we used mixed-effects regression models. The personality traits were treated as continuous variables, not discrete groups, and they were standardized so that the sample mean was centered at zero. The random intercepts and random slopes were allowed to covary to control for possible initial-value effects. The analyses were conducted in Mplus 8 using Bayesian estimation (based on Gibbs sampling with 5000 Marcov Chain Monte Carlo iterations) to enable standardized coefficients for the multilevel regression coefficients. All regression coefficients are standardized.

Pre-ejection period (PEP)

We first examined whether conscientiousness moderated the effects of incentives on PEP across the three periods. A mixed-effects regression model included the 6 HEXACO traits as between-person factors and time period as a within-person factor. Neither conscientiousness ($\beta = -.02$, $p = .414$) nor the other HEXACO factors had a significant between-person main effect. There was a significant within-person effect of time period, $\beta = -.62$, $p < .001$, reflecting a significant linear decline in PEP across the baseline/1 cent/5 cent periods. And finally, as expected, there was a significant interaction between conscientiousness and time period, $\beta = -.28$, $p = .015$.[2]

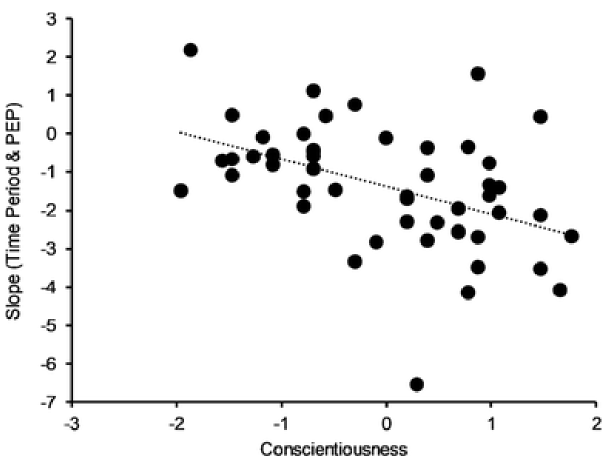


**Figure 1.** The interaction effect of conscientiousness and time period. As conscientiousness (*X* axis, standardized) increases, the slope on the *Y* axis—the rate of linear change in PEP across the baseline/1 cent/5 cents periods—becomes more negative. Because PEP values become smaller as beta-adrenergic influence on the heart increases, the pattern indicates greater baseline-to-task effort-related cardiac activity as conscientiousness increases

Figure 1 displays the multilevel interaction pattern as a scatterplot. Conscientiousness (in the *z*-metric) is on the *X* axis, and each participant's slope—the rate of linear change in PEP across the

[2] Regarding the other HEXACO factors, the between-person main effects on PEP were non-significant: honesty-humility ($\beta = .03$, $p = .398$), emotionality/neuroticism ($\beta = -.10$, $p = .163$), extraversion ($\beta = .01$, $p = .476$), agreeableness ($\beta = .06$, $p = .282$), and openness to experience ($\beta = .00$, $p = .494$). For the interaction of personality traits and time period, there was a significant interaction for emotionality, $\beta = -.28$, $p = .011$. As with conscientiousness, people higher in emotionality responded more strongly to the incentives. The interaction effects were not significant for honesty-humility ($\beta = -.03$, $p = .395$), extraversion ($\beta = .18$, $p = .089$), agreeableness ($\beta = .01$, $p = .460$), and openness to experience ($\beta = -.12$, $p = .166$).

baseline/1 cent/5 cents periods—is on the *Y* axis. Slopes closer to zero reflect little change across the time periods, whereas negative slopes reflect greater linear declines in PEP across the time periods. The slopes became increasingly negative as conscientiousness increased. Because PEP scores become smaller as beta-adrenergic influence on the heart increases, the interaction pattern indicates that people who were relatively higher in conscientiousness had greater effort-related change in cardiac activity.

RZ

The pattern of effects was essentially the same for RZ. A mixed-effects regression model found that neither conscientiousness ($\beta = -.02$, $p = .444$) nor the other HEXACO factors had a significant between-person main effect on RZ. There was a significant within-person effect of time period, $\beta = -.68$, $p < .001$, reflecting a significant decline in RZ across the baseline/1 cent/5 cent periods. And finally, as expected, there was a significant interaction between conscientiousness and time period, $\beta = -.24$, $p = .027$. The interaction pattern was essentially identical to the PEP interaction shown in Fig. 1.[3]

IBI

For IBI, a mixed-effects regression model found a significant between-person main effect involving conscientiousness, $\beta = -.17$, $p = .049$. The within-person main effect of time period was not significant, $\beta = -.20$, $p = .191$, nor was the interaction of conscientiousness and time period, $\beta = -.19$, $p = .116$.[4]

Performance and self-report outcomes

Because the task's incentive structure was piece-rate—people were rewarded for each correct item and told to get as many correct as possible—how many items people completed correctly serves as a measure of behavioral task performance. People completed essentially the same number of correct responses when offered 1 cent ($M = 80.34$, $SD = 11.59$) versus 5 cents ($M = 79.90$, $SD = 12.23$) for each one, $F < 1$. Did conscientiousness predict how many responses people got correct on the task? A multivariate regression model (with performance in both the 1 cent and 5 cent periods as outcomes, using maximum likelihood) showed that conscientiousness did not predict the number of items people completed for either the 1 cent ($\beta = .06$, $p = .617$) or

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[3] For the other HEXACO factors, the main effects on RZ were non-significant: honesty-humility ($\beta = -.01$, $p = .466$), emotionality/neuroticism ($\beta = -.14$, $p = .089$), extraversion ($\beta = -.04$, $p = .338$), agreeableness ($\beta = .03$, $p = .392$), and openness to experience ($\beta = -.01$, $p = .446$). For the interactions of personality traits and time period, there was a significant interaction for emotionality, $\beta = -.22$, $p = .034$. The interaction effects were not significant for honesty-humility ($\beta = -.06$, $p = .310$), extraversion ($\beta = .20$, $p = .056$), agreeableness ($\beta = .05$, $p = .349$), and openness to experience ($\beta = -.15$, $p = .107$).

[4] For the other HEXACO factors, the main effects on IBI were all non-significant: honesty-humility ($\beta = .14$, $p = .132$), emotionality/neuroticism ($\beta = -.12$, $p = .132$), extraversion ($\beta = .00$, $p = .476$), agreeableness ($\beta = .04$, $p = .344$), and openness to experience ($\beta = .07$, $p = .241$). For the interactions of personality traits and time period, there was a significant effect involving honesty-humility ($\beta = .28$, $p = .050$) but no other significant interactions: emotionality ($\beta = -.12$, $p = .238$), extraversion ($\beta = .05$, $p = .384$), agreeableness ($\beta = -.10$, $p = .276$), and openness to experience ($\beta = .23$, $p = .088$).

the 5 cent ($\beta = -.01$, $p = .953$) block. No significant relationships appeared for the other HEXACO traits.[5]

For the self-report items, conscientiousness did not significantly predict ratings of how hard they found the task ($\beta = -.09$, $p = .559$) or how well they did on it ($\beta = -.18$, $p = .201$), although the coefficients were in the negative direction. In addition, none of the other HEXACO traits significantly predicted either item.[6]

**Discussion**

In the present experiment, we examined how people with varying levels of conscientiousness respond to piece-rate cash incentives. Motivational intensity theory (Brehm and Self 1989) offers a useful perspective on the surprising and inconsistent findings for conscientiousness in past research (Fulmer and Walker 2015; Stewart 1996). Research guided by the theory emphasizes that effort, performance, and persistence commonly diverge. People often try harder without performing better, so drawing conclusions about effort from behavioral performance is complex.

Our results indicated a dissociation between performance and effort. For performance, conscientiousness did not significantly predict how well people did on the task. The null results mirror past experiments, which found null and negative results for conscientiousness and performance under piece-rate incentive conditions (Fulmer and Walker 2015). But physiological markers of effort—measured via changes in beta-adrenergic effects on the heart—suggested that people high in conscientiousness were indeed trying harder. Across both blocks, people higher in conscientiousness showed greater effort-related cardiac activity when working on the task compared to people lower in conscientiousness.

Additionally, the results suggest that while conscientious people exerted more effort in general, this was moderated by incentive level. Conscientious people exerted more effort during the higher incentive block (5-cent) than the lower incentive block (1-cent). This finding indicates that conscientious people are sensitive and responsive to incentives as motivation intensity theory would suggest. More specifically, if people high on conscientiousness were insensitive to monetary incentives, we would have expected to find no difference between the two incentive blocks. In the present experiment, however, we found a significant linear effect of incentive value that was significantly moderated by conscientiousness. In sum, it appears that conscientious people experience increased goal importance in proportion to increased incentives, as indicated by effort intensity. Conscientious people thus do not simply gear up for any and all goals, but rather calibrate their effort to the importance of the goal at hand.

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[5] For performance in the 1-cent and 5-cents conditions, respectively, no significant relationships were found for the other HEXACO traits: honesty-humility ($\beta = -.12$, $p = .404$; $\beta = -.28$, $p = .075$), emotionality ($\beta = .24$, $p = .092$; $\beta = .00$, $p = .996$), extraversion ($\beta = -.09$, $p = .405$; $\beta = .00$, $p = .978$), agreeableness ($\beta = .05$, $p = .746$; $\beta = .11$, $p = .424$), and openness to experience ($\beta = -.05$, $p = .732$; $\beta = .02$, $p = .902$).

[6] For ratings of how difficult people found the task and how well they did on it, respectively, the other HEXACO factors had non-significant relationships: honesty-humility ($\beta = .19$, $p = .203$; $\beta = -.23$, $p = .151$), emotionality ($\beta = -.03$, $p = .851$; $\beta = .07$, $p = .609$), extraversion ($\beta = .24$, $p = .127$; $\beta = -.06$, $p = .710$), agreeableness ($\beta = -.23$, $p = .086$; $\beta = .23$, $p = .102$), and openness to experience ($\beta = .09$, $p = .552$; $\beta = .05$, $p = .696$).

Greater effort is more intuitively consistent with models of conscientiousness as a personality trait. In addition to having components associated with being conventional and organized, conscientiousness is associated with high motivation, such as working diligently, holding oneself to high standards, and delaying short-term gratification in favor of long-term outcomes (Roberts et al. 2007). It would be surprising if people high in conscientiousness didn't try harder when faced with a task that appears important (i.e., has incentives attached to performance). But they won't necessarily perform better, given the many factors associated with task performance.

One limitation of the current study is the lack of blood pressure measurement. PEP was used to measure sympathetically-mediated contractility, but PEP can also be affected by ventricular preload and afterload effects (Mohrman and Heller 2013). The present study did not measure blood pressure, which can be useful in evaluating potential preload and afterload confounds. Past research, however, shows that such confounds are highly unlikely in the present paradigm, in which people are seated, still, and engaged in an appetitive task, as opposed to tasks involving physical exertion or passively enduring unpleasant stressors (Obrist et al. 1987). In addition, the sample size may have prevented us from finding higher-order effects involving the counterbalancing factors, so possible differences as a function of order (e.g., ascending versus descending rewards) await examination in future research.

An interesting issue for future research is to dig into why conscientiousness is associated with greater effort but not better performance. One possibility concerns task strategies that conscientious people would be more likely to apply. For example, if people use strategies associated with avoiding mistakes, such as slowing down or double-checking their responses before answering, they will not get as many correct responses within a time limit. Additionally, future studies examining effort-related cardiac activity in people high and low in conscientiousness should include a no-incentive condition. The purpose of the current experiment was to examine the effect of incentive values on effort-related cardiac activity; however, it would also be interesting to identify whether people high in conscientiousness in general have higher levels of effort-related cardiac activity that is also inconsistent with their performance.

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