Japanese Journal of Applied Psychology
2012, Vol. 38 (special edition), 92–100

Minor Study

Variance Trend in Reaction Time for Personality Traits

—Personality Traits of Version and Emotional Stability—

Emi SATO[1] and Kouhei MATSUDA[2]

This experiment measured RT to personality trait terms and examined RT to personality trait terms by personality. Our two hypotheses are: (1) RT to presented personality trait term has the feature of *means* of RT to presented trait term and (2) These RTs have a variance trend for each personality. By taking into account the effect of *SD* about RT, we examine individual differences and the intraindividual differences of RT to personality trait terms. This experiment was operationally defined using three processing models: DRT, SRT, and PRT. The result of *ANOVA* indicated a major effect for version score. Introverts indicated a greater change of reaction and judgment than did extroverts on SRT and PRT. And, there was a major effect for emotional stability scores on PRT but not on SRT. By examining the amount of RT change from the *means* of each participant, it was possible to determine intraindividual differences for personality traits from the quantitative RT data.

Key words: reaction time, personality trait term, personality traits

INTRODUCTION

Human behavior is derived from personality; thus, throughout the ages there has been an interest in the variety of behavior based on personality. The field of personality science involves three distinct research traditions, each with its own approach to observation: clinical, correlational, and experimental (Pervin, 1993). The experimental approach involves systematic manipulation of variables to establish causal relationships using the psychophysiological and behavioral approach. Experimental research examines the relationship between personality traits and the quantitative data on physical reactions to stimuli.

In early personality research, extroversion and nervousness is a factor in which it is coherent as the personality traits. Eysenck presented the biological-based Introversion-Extroversion (IE) theory. In addition, his study of neurosis addressed individual differences in the autonomous nervous system (Eysenck, 1967). Many behavioral and psychophysiological studies have since been based on Eysenck's arousal theory of IE. In an attempt to assess physiological arousal differences between introverts and extroverts, many experiments have used heart rate, electroencephalography, and reaction time (RT). The relationship between IE and RT performance depends on the parameters of the experiment protocol used. RT is an approximate value that signifies the complex sum of biological responses and psychological effects (Chocholle, 1963).

In cognitive psychology research, RT focuses on the relationship between stimulus and reaction; it is used for objectively measurable and quantitative data. RT can be represented in quantitative terms and is not dependent upon subjective cognitive performance-based coding techniques (McClelland, 1987). For this reason, it is

[1] Tokyo Fuji University, Shimoochiai, Shinjuku-ku,Tokyo 161–8556, Japan
E-mail: karen@ff.iij4u.or.jp
[2] Tohoku-bukyo College, 515 Katayachi, Yamagata-shi, Yamagata 990–2316, Japan
E-mail: kmatsuda@marie.kakio.gr.jp

considered to be objective (MacLeod, 1993). The available research on IE and RT may be summarized with three general conclusions (Bullock and Gilliland, 1993). (1) Extroverts perform as well as, and often better than, introverts on moderately arousing RT tasks (relatively short internal intervals and time-on-task of no more than 20 min) (Buckalew, 1973). (2) Either on a relatively slow-paced, non-arousing RT task or on an RT task in which time-on-task extends to approximately 40 min, extroverts have slower RT than introverts (Brebner and Cooper, 1974). (3) As RT complexity increases (as in the choice RT task), or as the intensity of the RT stimulus increases, extroverts have faster RT than introverts; but they also tend to produce more errors of commission (Brebner and Flavel, 1978; Dickman and Meyer, 1988). In a previous study, it was possible to distinguish introversion and extroversion with a personality experiment using RT. Though some factors are evident in RT, we assume that introversion and extroversion are related to biological reaction.

Additionally, neuroticism is a personality factor that influences RT. Higher neuroticism scores were associated with slower RT, which is also regarded as an index of information processing speed (Robert et al., 1993). Neuroticism is associated with variability in stimulus-response behavior as measured by RT (Robinson and Tamir, 2005).

In the study of version and neuroticism, it is thought that RT represents personality traits. Therefore, we investigate the relationship between RT and personality traits. A previous experiment measured RT relative to personality trait terms and examined the relationship between RT and personality traits related to extroversion and emotional stability in the Big Five Personality Inventory (Sato and Matsuda, 2009). This experiment measured time to react to a personality trait terms of version and emotional stability. Based on the study of Allport and Odbert (1936), the study of personality trait terms could reveal an aspect of their semantic meaning. The development of personality trait term research is the basis of the Big Five Theory. Personality trait terms may represent one's personality impression, and they may arouse various reactions when used to evaluate others. As the quantitative index of this, time to react to a personality trait term may include the personality's biologic response. We hypothesize that RT to presented personality trait term has the feature of *means* of RT to presented trait term, and that these RTs have a variance trend for each personality.

We assume two factors of RT to presented personality trait term: quantitative data obtained from RT, and individual variation.

Regarding quantitative data, RT data is a value of various sum totals of a factor reacted to a stimulus. It is necessary to assume about the quantitative data from physical reaction to a stimulus that related to the personality although RT included the complex sum of biological responses and psychological effect. To address the issue of quantitative data, this experiment was conducted in two sessions. We obtained each participant's RT to the stimulus and RT of the judgment of self-rating for the personality trait term. In a simple response session, we assume that each participant has an RT for a certain personality trait term. However, in the personality self-rating session on a monopole scale, we assume that each participant has an RT of matching and judging one's own personality. We examine the raw RT data on the personality self-rating session using the monopole scale. This experiment examines RT using personality trait terms of version and emotional stability.

RT has intraindividual difference in each stimulus term. With the behavioral approach, it is difficult to specify this individual variation, and the relationship between personality trait and data on reaction to a stimulus is unclear. Individual differences are cited in cognitive psychology as one determining factor in simple RT (Oyama, 1986). Because of significant differences between individuals, when researchers measure physical reaction to a stimulus, much variation exists in the *mean* RT. RT measurement in a previous study indicated that each participant has variability in stimulus-response behavior. In addition, intraindividual differences in RT were great for each personality trait term (Sato and Matsuda, 2009).

Therefore, in order to examine intraindividual

differences in this experiment, we focus on the standard deviation (*SD*) of RT, rather than *means*. According to data from a previous study, the RT *SD* is likely to assess noise in an information-processing system (Baumeister, 1998). SDs of RT is typically viewed as error, but such error (from trial to trial) is an individual difference (Baumeister, 1998; Jensen, 1992; Rabbitt et al., 2001).

By taking into account the effect of *SD* about RT, we examine individual differences and the intraindividual differences of RT to personality trait terms; one is the amount of change in response to a stimulus, and the other is the amount of change in each participant's self-rating of the judgment. Thus, this experiment was operationally defined using three processing models: decision reaction time (DRT), stimulus reaction time (SRT), and personality reaction time (PRT). DRT is the time required for one's own personality judgment, using the time obtained in a simple response session and in a personality self-rating session.

Furthermore, we assume as intraindividual difference that RT's model sets at the amount of change of response to stimulus, and at the amount of the change of the judgment of one's own personality. Thus, we define the amount of change in SRT and PRT as follows. SRT is the time required for a participant's change of response to a stimulus. Neuroticism has been associated with temporal variability (Eysenck and Eysenck, 1985). In consideration of the individual variation of the reaction to a stimulus, SRT examines the variation of each participant's response to a stimulus. PRT is the time for each participant's self-rating. To the extent that such deviations are higher, individuals are less effective in regulating their behavior over time, at least with reference to the specific processing task (Rabbitt et al., 2001). In consideration of the judgment time of one's own personality, PRT examined the variation in each participant's judgment by personality traits. Three models were used to examine intraindividual variability for RT to personality trait term.

Focusing on quantitative data and individual variation in RT, we examined interindividual and intraindividual differences.

PURPOSE

This experiment measured RT to personality trait terms and examined RT to personality trait terms by personality. Our two hypotheses are: (1) RT to presented personality trait term has the feature of *means* of RT to presented trait term. And, (2) These RTs have a variance trend for each personality.

METHOD

Participants The participants were 26 university undergraduate and graduate students (14 males, 12 females), aged 20 to 30 years.

Experiment period June 2010

Stimulus terms On the two axes of extroversion factors and emotional stability factors, we selected personality trait terms that would be easily recognized by and familiar to university students (Table 1). Self-imagery targeting university students was used heavily; personality trait terms with three Japanese characters and had similar Japanese grammatical structure (ending with "na") were selected.

Visual stimuli To enable easy visual perception from a personal computer (PC) screen (25×18.5 cm), 13 personality trait terms were set as com-

Table 1. The stimuli terms of personality trait terms used in experiment

Practice stimuli	Sincere (正直な)	Naivety (単純な)	Easygoing (気楽な)		
Version stimuli	Calm (無口な)	Inconsiderate (軽率な)	Quiet (静かな)	Lively (元気な)	Cheerier (陽気な)
Emotional stability stimuli	Irritable (短気な)	Amenable (素直な)	Docile (従順な)	Selfish (勝手な)	Anxious (不安な)

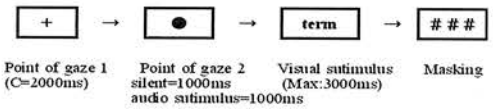

Fig. 1. Experimentation block diagram of a simple response session.

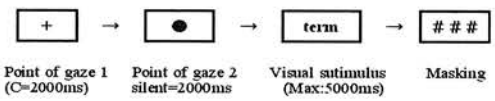

Fig. 2. Experimentation block diagram of a personality self-rating session.

puter image files, such that the Japanese text size was 4 cm, or $\theta = 57.3 \times d/D$ (θ=angular subtense (degree), d=stimulus size (cm), D=viewing distance (cm)).

Auditory stimuli Thirteen trait terms were recorded on a PC in a male voice (1000 ms length).

Equipment The equipment included a laptop computer (Fujitsu FMV-5233NU/W), E-prime2.0 (psychology software tool), and headphones,;

Personality inventory A total of 70 items were used from the scale construction of a Big Five Personality Inventory (Murakami and Murakami, 1997). Each analysis used 12 extroversion scale items and 12 emotional stability scale items.

Procedure This experiment was designed to be completed in 30 to 35 min. It was executed by the following six procedures.

1) Practice session: Participants practiced two or three times in a simple response session.

2) Simple response session (Fig. 1): After displaying a point of gaze (+) (2000 ms) on the PC, we displayed a black dot (●) (1000 ms). Upon seeing the black dot, participants pushed a key in response to the personality trait term that they heard via a headphone and saw displayed on the PC. If the audio and visual stimulus (five extroversion stimulus terms and five emotional stability stimulus terms) matched, they pressed "○." If the terms did not match, they pressed "×." The trial was assigned randomly for each participant. After participants had pressed a key, one trial was finished (Masking). Participants performed 100 trials.

3) Rest break

4) Personality self-rating session by monopoles scale (Fig. 2): After displaying a point of gaze (+) (2000 ms) and a black dot (●) (2000 ms) , we randomly displayed personality trait terms on the PC. When participants saw a personality trait term that they believed applied to them, they pressed "○." If they did not think it applied to them, they pressed "×." One trial was then finished (Masking). Participants performed 50 trials.

5) Personality self-rating session by bipolar scale (64 trials)

6) Inventory: Scale construction of a Big Five Personality Inventory.

Analysis In the simple response session, RT was analyzed in 100 trials that utilized auditory and visual stimuli. In the personality self-rating session, we analyzed participants' RT assessing 10 personality trait terms. N was the number of trials ×participants. Because of the possibility of variance due to lost values or non-responses for repetitions in each criteria combination, an analysis of variance (*ANOVA*) was performed. We used the General Linear Model (*GLM*) from the Statistical Analysis System (SAS) statistics software package (Takeuchi et al., 1996). After classifying each participant's personality traits using the personality inventory, we examined RT to each term and personality traits.

Inventory Big Five Personality Inventory extroversion scores and emotional stability scores were calculated for each participant. Defining a score exceeding the version score center value (above 18) as extroverted and a score exceeding the emotional stability score center value (above 5) as emotionally stable, the personality traits of each individual were established as the base criteria according to traits assessed by the inventory.

Model We examined RT in the personality self-rating session. RT to personality trait terms indicated significant differences between individuals. To examine intra-individual variation in RT, we operationally defined three processing models: DRT, SRT, and PRT.

It was possible to examine the amount of intra-individual variability for personality traits. We calculated the numerical value of each model and

Table 2. Eximing RT to personality trait term and three model

	RT	RT on personality self-rating session by monopoles scale
Model 1	RT−mrt	Time of decision personality model (DRT)
Model 2	(RT−mrt)/mrt	The increasing rate of stimuli to reaction time model (SRT)
Model 3	(RT−mrt)/RT	The increasing rate of personality valuation time model (PRT)

mrt: Means of RT in simple response session.

Table 3. Means of RT in simple response session

Stimulus terms		Mean (ms)	StdDev	StdErr
Version Stimuli	Calm	632.0	188.7	16.75
	Inconsiderate	610.3	177.5	15.63
	Quiet	593.9	168.4	14.89
	Lively	561.5	183.7	16.24
	Cheerier	608.3	161.6	14.34
Emotional stability stimuli	Irritable	662.4	206.7	18.57
	Amenable	628.4	228.1	20.40
	Docile	631.8	237.9	21.28
	Selfish	572.3	170.0	15.20
	Anxious	599.7	181.7	16.19

performed a two-way *ANOVA* for the version score and emotional stability score by each model.

RT: This was raw RT data in the personality self-rating session determined by the monopole scale. Although it was possible to examine intraindividual differences in RT to personality trait terms, we assumed that RT included various factors in the personality self-rating session.

Model 1. Decision reaction time (DRT): DRT was determined by subtracting the *means* of RT in the simple response session from the RT of each participant in the personality self-rating session. This model set the judgment time, based on Donders (1969), in order to determine whether personality trait terms match the participant's personality, using the time required to judge one's own personality. It was thought that each participant had an individual pace when evaluating his or her own personality from stimulus terms.

Model 2. Stimulus reaction time (SRT): Based on each participant's response time to a stimulus in a simple response session, we examined the variation of each participant's response to a stimulus by personality traits. Significant association between personality traits and SRT was expected.

Model 3. Personality reaction time (PRT): Based on each participant's time of judgment in the personality self-rating session, we examined the variation in each participant's judgment by personality traits. Significant association between personality traits and PRT was expected.

RESULTS

We examined the *means* of RT to personality trait terms in the simple response session (Table 3). We determined RT, *SD*, and 95% critical limit mean of RT (ms) for version and emotional stability. The shortest RT was 561.5 ms for the term "lively," while the longest RT was 662.4 ms for the term "irritable." Reaction times to the stimuli varied widely among individuals.

This experiment clarified the feature for personality traits and the variance in the personality self-rating session by the monopoles scale and ex-

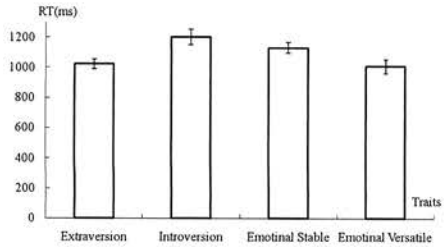

Fig. 3. RT on personality self-rating session by monopoles scale.

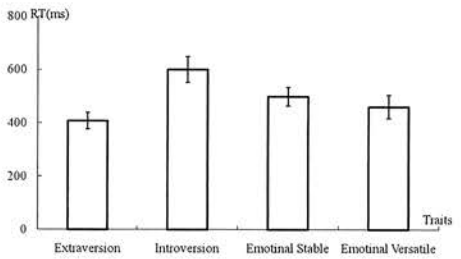

Fig. 4. Means of RT on time of decision personality model (DRT).

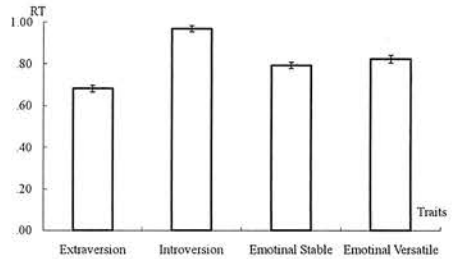

Fig. 5. Means of RT on the increasing rate of stimuli to reaction time model (SRT).

amined raw data of RT to personality trait terms and three models. Figures 3 through 6 indicate RT, *SD*, and 95% critical limit mean of RT (ms) for personality traits.

Result 1. Two-way ANOVA of stimulus terms × version score

In order to examine the variance trend for the version score, a two-way *ANOVA* was performed on RT for each model.

1–1. RT on personality self-rating session for version score: A two-way *ANOVA* was performed for RT in the personality self-rating session for stimulus terms × version score (Fig. 3). No significance was found for stimuli ($F(9, 1018)=1.77$, *n.s*). The major effect for version score ($F(1, 1018)=36.80$, $p<.01$) indicated a significant difference for stimulus terms × version score ($F(9, 1018)=2.18$, $p<.05$). However, using the Tukey method, a two-way interaction indicated no significant differences.

1–2. DRT for version score: A two-way *ANOVA* was performed for DRT for stimulus terms × version score (Fig. 4). No significance was found for stimulus terms ($F(9, 1018)=1.97$, *n.s*). There was a major effect for version score ($F(1, 1018)=46.87$, $p<.01$). RT of extroversion was shorter in personality valuation time. A significant difference was indicated for stimulus terms × version score ($F(9, 1018)=2.47$, $p<.05$). However, a two-way interaction measured by the Tukey method indicated no significant difference.

1–3. SRT for version score: A two-way *ANOVA* was performed for SRT for stimulus terms × version score (Fig. 5). There was a major effect for stimuli ($F(9, 1018)=2.29$, $p<.05$). The Tukey method indicated a significant difference between "inconsiderate" and "lively" for version stimuli, and between "inconsiderate" and "amenable" and "docile" for emotional stability stimuli. The RT *means* were 1.03 for "inconsiderate," 0.71 for "lively," and 0.72 for "amenable" and "docile." The major effect for version score ($F(1, 1018)=43.21$, $p<.01$) indicated a significant difference for stimulus terms × version score ($F(9, 1018)=2.66$, $p<.05$). For the two-factor interaction, the RT *means* for "inconsiderate" were 0.95 for extroversion and 1.13 for introversion.

1–4. PRT for version score: A two-way *ANOVA* was performed for PRT for stimulus terms × version score (Fig. 6). There was a major effect for stimuli ($F(9, 1018)=3.76$, $p<.05$). The Tukey method indicated a significant difference between "inconsiderate" and "lively" for version stimuli, and between "inconsiderate" and "docile" for emotional stability stimuli. It indicated a significant difference between "lively" and "selfish" and between "lively" and "irritable" for emotional stability stimuli. The RT *means* were 0.43 for "inconsiderate," 0.41 for "selfish" and "irritable,"0.31 for "lively," and 0.34 for "docile."

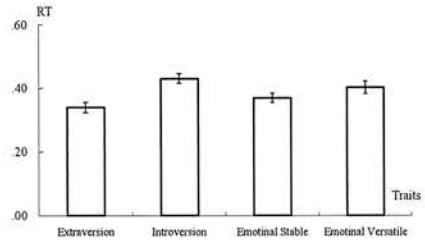

Fig. 6. Means of RT on the increasing rate of personality valuation time model (PRT).

The major effect for version score ($F(1, 1018)=61.83$, $p<.01$) indicated a significant difference for stimulus terms×version score ($F(9, 1018)=3.09$,$p<.05$).

Result 2. Two-way *ANOVA* of stimulus terms× emotional stability scores

We examined RT to presented personality trait termsz of the variance trend for emotional stability scores and performed a two-way *ANOVA* of RT for each model.

2–1. RT of personality self-rating session for emotional stability scores: Regarding RT in the personality self-rating session for stimulus terms ×emotional stability scores (Fig. 3), no significance was found for the stimulus term ($F(9, 1018)=1.69$, *n.s*). There was a major effect for emotional stability scores ($F(1, 1018)=12.95$, $p<.01$). No significance was found for stimulus term×emotional stability scores ($F(9, 1018)=0.08$, *n.s*).

2–2. DRT for emotional stability scores: A two-way *ANOVA* was performed for DRT for stimulus terms×emotional stability scores (Fig. 4). No significance was found for stimulus term ($F(9, 1018)=1.85$, *n.s*), for emotional stability scores ($F(1, 1018)=1.34$, *n.s*), or for stimulus term×emotional stability scores ($F(9, 1018)=0.88$, *n.s*).

2–3. SRT for emotional stability scores: A two-way *ANOVA* was performed for SRT for stimulus terms×emotional stability scores (Fig. 5). There was a major effect for stimuli ($F(9, 1018)=2.16$, $p<.05$). No significance was found for emotional stability scores ($F(1, 1018)=0.42$, *n.s*) or for stimulus term×emotional stability scores ($F(9, 1018)=0.92$, *n.s*).

2–4. PRT for emotional stability scores: A two-way *ANOVA* was performed for PRT for stimulus terms×emotional stability scores (Fig. 6). There was a major effect for stimuli ($F(9, 1018)=3.51$, $p<.01$) and for emotional stability scores ($F(1, 1018)=5.81$, $p<.05$). No significance was found for stimulus term×emotional stability scores ($F(9, 1018)=0.80$, *n.s*).

Discussion

This study examined two hypotheses. In hypothesis 1, RT to presented personality trait terms featured *means* of RT to presented personality trait terms. As a result of ANOVA, RT to personality trait terms were similar to RT to personality traits. The features of RT for each personality trait are described below.

Version score

The result of *ANOVA* indicated a major effect for version score. It suggested a difference between extraversion and introversion for RT to presented personality trait terms. This experiment indicated that the *mean* of RT for extroversion tended to be shorter than that for introversion in each model. For the choice RT task, extroverts had shorter RTs than introverts (Brebner and Flavel, 1978). Seen to Fig. 4, although the extroverted participant was quick to decide the self-rating in response to stimulus terms on DRT, there was a variation in judgment as indicated by the *SD*.

In contrast, the feature of introversion at RT *means* was slower RT and DRT. Seen on DRT, the extroversion *SD* was 391.03, and the introversion score was 520.61 (Fig. 4). DRT results indicated that it takes a long time for introverts to think about their own personality. And seen to SRT and PRT, Introverts indicated a greater change of reaction and judgment than did extroverts. Stimulus analysis indicates that with respect to individual differences in excitation, introverts exhibit longer stimulus inspection time than extroverts for simple stimuli (Brebner and Cooper, 1978). In this experiment, as participants with low extroversion scores (introversion) introspect the judgment of the self-rated to personality trait term repeatedly, it suggested that SD of introversion has variation and there are many amounts of change. This ex-

periment suggested that it was possible to show the feature of version RT from the amounts of change of RT by tree model.

Emotional stability score

Results of *ANOVA* indicate a major effect for emotional stability scores on RT in the personality self-rating session and PRT. *Means* of emotional versatile were shorter than those of emotional stabile (Fig. 3). However, as the *mean* of emotional versatile was 0.40 for PRT, the amount of change for emotional versatility was greater than for emotional stability (Fig. 6). This result suggests that though emotionally versatile participants were quick to make a decision, they tended to exhibit much change of judgment by the self-rating a stimulus terms repeatedly. In contrast, though emotionally stable participants were slow to make a decision, they could react at a constant speed the self-rated by a stimulus terms. No significance was found for emotional stability scores on DRT and SRT, suggesting no difference in RT to judge one's own personality.

Effect of three models

For hypothesis 2, RTs to presented personality trait terms has a variance trend for each personality trait. Investigation by SRT and PRT clarified the amount of change with personality traits.

There was a major effect for version score on SRT and PRT. Introverts and extroverts differ in their expression of motor behavior on a variety of tasks that require a simple motor response, with extroverts tending to initiate faster and more frequent responses than introverts (Stelmack, 1985).

Considering the difference between extroversion and introversion, introversion had large *means*, whereas extroversion had small *means* for both SRT and PRT. The reason for the amount of change of reaction and judgment is adaptation to an experiment condition or a stimulus term. According to the Brebner-Cooper model, extroverts are "geared to respond," whereas introverts are "geared to inspect" under moderated arousing environment conditions (Brebner and Cooper, 1974). The reason for the large amounts of change for introversion may be that it took long time for introversion to adapt to experiment. And, the reason with little quantity of change for extroverts was "geared to respond", it suggested that extroverts adapt quickly to stimulus term. Considering that significant difference for stimulus terms × version score were observed for only extroverts, it is possible that extroverts reacted in specific ways to specific stimuli. In future experiments, we may need to select a stimulus term.

There was a major effect for emotional stability scores on PRT but not on SRT. This result suggested that the emotional stability score indicated the amount of change in RT for each participant's self-rating. It may be necessary to examine another stimulus term and another factor of intraindividual difference for emotional stability scores. It was suggested that the difference in an individual in a version score could be discriminated from extroversion to introspection by RT to a personality trait term.

By examining the amount of RT change from the *means* of each participant, it was possible to determine intraindividual differences for personality traits from the quantitative RT data. These results suggest that RT may provide evidence of personality traits.

REFERENCES

Allport, Odbert 1936 Trait-names: A psycho-lexical study. Psychological Monograph, **47**, 1–37.

Baumeister, A. A. 1998 Intelligence and the "personal equation." *Intelligence*, **26**, 255–265.

Brebner & Cooper, 1978 Stimulus-or response induced excitation. A comparison of behavior of introverts and extraverts. *Journal of Research in Personality*, **12**, 306–311.

Brebner, J. & Cooper, C. 1974 The effect of a low rate of regular signal upon the reaction times of introverts and extraverts. *Journal of Research in Personality*, **8**, 263–276.

Brebner, J. & Flevel, R. 1978 The effect of catch-trials on speed and accuracy among introverts and extraverts in simple RT task; *British Journal of Psychology*, **69**, 9–15.

Buckalew, L. W. 1973 Relationship between a physiological and personality index of excitability. *Physiological Psychology*, **1**, 158–160.

Chocholle, R. 1963 *Temps de reaction.* P. Fraisse & J.

Piaget (Eds.) *Trait de Psychologie experimentable.* Frascicule2: Sensation et Motricite. Press Universals de France, Paris.

Dickman, S. J. & Meyer, D. E. 1988 Impulsivity and speed-accuracy tradeoffs in information processing. *Journal of Personality and Social Psychology*, **54**, 274–290.

Donders, F. C. 1969 On the speed of mental process. In W. G. Koster (Ed. & transl.), Attention and performance (pp. 412–431). Amsterdam: North-Holland. (Original work published 1868.)

Emi Sato, Kouhei Matsuda 2009 The relation between personality traits and reaction times to personality trait terms.—Personality traits of Extraversion-Introversion, Nerves-Toughness— *The Japanese Journal of Applied Psychology*. Vol. 34. 72–81.

Eysenck, H. J. 1967 The biological basis of personality. Springfield, Illinois: Thomas.

Eysenck, H. J. & Eysenck, M. W. 1985 *Personality and Individual difference: A natural science approach.* New York: Plenum Press.

Jensen, A. R. 1992 The importance of intraindividual variation in reaction time. *Personality and Individual Differences*, **13**, 869–881.

MacLeod, C. 1993 Cognition in clinical psychology: Measure methods, or models? *Behavior Changes*, **10**, 169–195.

McClelland, D. C. 1987 *Human Motivation*. New York: Cambridge University Press.

Pervin, L. A., 1993 *Personality: Theory and research*, 6th ed. John Wiley & Sons.

Rabbitt, P., Osman, P., Moore, B., & Stollery, B. 2001 There are stable individual differences in performance variability, Both from moment to moment and from day to day. Quarterly Journal of Experimental Psychology: *Human Experimental Psychology*, **54A**, 981–1003.

Robinson, M. D. & Tamir, M 2005 Neuroticism as Mental Noise: A relation Between Neuroticism and Reaction time Standard Deviation. *Journal of Personality and Social Psychology*. **89**, 107–114.

Stelmack, R. M. 1985 Personality and motor activity: A psychophysiological perspective. In B. Kirkcaldy (Ed.), *Individual difference in movement* (pp. 192–213). Lancaster, England: Medical & Technical Publications.

Tadasu Oyama 1986 The history and the present conditions of a reaction time study. *Human Engineering*, **21**(2), 57–64.

Yoshihiro Murakami & Chieko Murakami 1997 Scale construction of a "Big Five" personality inventory. *The Japanese Journal of Personality*, **6**(1), 29–39.

Walter Schneider, Amy Eschman, and Anthony Zuccolotto 2002 E-Prime Reference Guide Leaning Research and Developmental Center, University of Pittsburgh.