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Task Switching Methodology: A Platform for Indirect Measures of Evaluation and
Evaluative Personality Processes

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Abstract

In this paper, the authors review studies involving switching between an evaluative task and a non-evaluative task as a means to indirectly assess evaluative processes in the context of research of attitudes, psychopathology and personality traits. Two task switching indices, Switching Cost and Task Rule Congruency Effect, which represent two distinct sets of processes, have been used so far and can be assessed simultaneously. The authors suggest that using task-switching methodology as a platform provides significant methodological as well as theoretical advantages, which they attribute to the heightened involvement of the individual's goal system, characterizing the task switching paradigm.

Keywords: Indirect measures, task-switching, attitudes, personality, emotion, evaluation.

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1. Introduction

Indirect measures of evaluation and personality are increasingly used by researchers in an effort to overcome the limitations of self-reports (Gawronski & De Houwer, in press; Greenwald & Banaji, 1995; Nisbett & Wilson, 1977). In the present selective review we focus on a group of measures which employ the task-switching (TS) paradigm as their platform. We argue that this platform imbues several important advantages, both theoretical and methodological.

We first provide a description of a typical TS paradigm. Second, we review studies that employed TS designs to measure individual differences in evaluative processes which are related to depression and anxiety. Third, we review studies that used a specific phenomenon in TS, the Task Rule Congruency Effect (TRCE), as a measure of individual differences in evaluative processes related to attitudes and personality traits. Finally, we suggest a theoretical perspective shedding light on the advantages of using TS as a tool to measure individuals' evaluative processes that are linked to attitudes and activation of personality traits.

We define *evaluation* as any behavior that indicates liking or disliking of an object (De Houwer, 2009). The psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor is an *attitude* (Eagly & Chaiken, 1998). *Evaluative processes* are psychological processes that lead to evaluation. When these processes are related to the activation of personality traits (e.g., Mischel & Shoda, 1995), we label them 'evaluative personality processes.'

2. Task Switching

The TS paradigm was initially developed as a tool to study the ability to change mindset (Gibson, 1941; Jersild, 1927). Mindset is a concept describing the temporary configuration of the mental system which makes it ready to carry out a particular activity. For example, driving home, one may engage in a self-critical mindset, focusing on personal faults and shortcomings, but then may snap out of the mindset to address the task of finding a parking lot. TS is a means to operationalize both the term mindset and the ability to switch between mindsets, assuming that a change in task should be accompanied by a change in mindset given the different requirements associated with executing different tasks.

Early studies on TS focused on the ability to flexibly change mindset regardless of the content of these mindsets. Currently, the ability to shift a mindset is widely considered one of several core executive functions (e.g., Miyake et al., 2000). Much of the research on TS emphasized its cognitive and neurological underpinnings (Kiesel et al., 2010; Koch, Gade, Schuch, & Philipp, 2010; Meiran, 2010; Shallice, Stuss, Picton, Alexander, & Gillingham, 2008; Vandierendonck, Liefoghe, & Verbruggen, 2010), and used it to investigate the role of cognitive flexibility in various forms of psychopathology (Cepeda, Cepeda, & Kramer, 2000; Meiran, Levine, Meiran, & Henik, 2000). Yet, as we note in this review, there is a growing use of TS-based methodologies in the research on attitudes, psychopathology and personality. These lines of research utilize TS-based methodologies to focus on mindsets relevant to specific attitudes or personality processes rather than on the general ability to switch between mindsets. In that case, successful or rapid switching depends on individual differences regarding the specific mindsets and not only the general ability to switch between mindsets. In this review we focused on studies that involved switching between evaluative and non-evaluative tasks or mindset (in some cases the tasks are emotional vs. non-emotional, see e.g., Johnson, 2009; Schuch, Werheid, & Koch, 2012).

A typical TS paradigm involves switching between two (or more) simple cognitive tasks. The tasks could be executed on the same set of stimuli (bivalent stimuli). For example, digit stimuli can be categorized by numerical size (larger/smaller than 5) or parity (odd or even). Alternatively, each task could be executed on a unique set of stimuli (univalent stimuli), for example categorizing the shape of a form (Task A) and categorizing the valence of a word (Task B). When bivalent stimuli are used, there is no way for participants to know from the stimulus itself which task is required (e.g., whether to judge “6” as larger than 5 or as an even number). There are several different methods to instruct participants which task is required. Some use a repetitive sequence of tasks such as AA-BB-AA (for Tasks A and B, see Rogers & Monsell, 1995). Others explicitly announce the task at the beginning of the experimental trial by means of a task-cue (Meiran, 1996; Shaffer, 1965).

TS paradigms provide several indices; some of them involve a comparison between performance in different block types (Block comparisons), while others involve comparison between performance in different types of trials (Trial comparisons). The focus of this review is on two indices produced by trial comparisons: Switching Cost (SC) and Task Rule Congruency Effect (TRCE).

3. Studies focusing on SC

In TS procedures, a trial is defined as a *repeat trial* if an identical task rule was relevant in the current trial (Trial N) and the previous trial (Trial N-1); otherwise it is defined as a *switch trial*. Research shows poorer performance, seen in reaction time (RT) and errors, in switch trials relative to repeat trials. This discrepancy is known as the SC.

In order to switch between two tasks one needs to first enter into a given mindset (engage in it). Then, one is required to maintain the mindset as long as needed. Finally, one needs to disengage from the mindset once a new mindset becomes relevant. That is, task switching is related to at least three processes: engaging, maintaining, and disengaging. However, Allport, Styles, and Hsieh (1994) tied between maintaining and disengaging. They noted that difficulty in *disengaging* from the previous task/mindset is a function of the effort that was required in order to maintain the preceding task. Presumably, when one strongly maintains a particular mindset, this makes it difficult to disengage from it. Thus the two processes of maintenance and disengagement seem to be tied to each other at least when SC is concerned.

Taking all the above into account, if the SC from task A to task B (AB-SC) is greater than the SC from task B to task A (BA-SC) then three explanation can be suggested: Task A is more difficult to maintain; Task A is more difficult to disengage from; or, Task B is easier to engage in.

It is possible to use SC to measure individual differences in the ability to disengage from a certain mindset. This can help to detect mindsets that are relatively easy to maintain in specific groups of people. Johnson (2009) focused on SC from a neutral task to an emotional task as a measure of individual differences in the context of anxiety, using an explicit TS cuing paradigm. Specifically, the target stimuli were faces with a shape centered between the eyes. Participants were asked to switch between categorizing the emotional expression on the face (happy, angry, neutral), and the type of shape. The results indicated that the switch cost from the neutral task to the emotional task (SC-NE), but not the SC from the emotional task to the neutral task, was higher for individuals characterized by high trait anxiety and worrisome thoughts. In another experiment, Johnson (2009) found that, even after controlling for trait anxiety, the SC-NE was negatively correlated with the amount of time participants spent on a frustrating anagram task that was executed just afterwards, and positively correlated with self-rated frustration. Johnson reasoned that SC-NE reflects difficulties in disengaging from a neutral set and engaging in an emotion-related mindset, and thus higher SC-NE can be interpreted as indicating avoidance from engaging an emotional context.

Sheppes, Meiran, Gilboa-Schechtman, and Shahar (2008) utilized Allport et al.'s (1994) notion, relating difficulties in maintaining the preceding task set to difficulties in disengaging from that task, in order to assess individual differences in the difficulty associated with maintaining negative self-concept among dysphoric and non-dysphoric individuals. Participants were divided into a dysphoric vs. non-dysphoric group according to the clinical cutoff of 16 in the CES-D questionnaire (Radloff, 1977), indicating depression. Negative self-concept was assessed using a new paradigm, involving frequent switching between a task demanding self-reference and a closely matched neutral task.

Sheppes et al.'s (2008) self-related task was a variant of the Implicit Association Test (IAT). The IAT (Greenwald, McGhee, & Schwartz, 1998) is widely used as an indirect measure of attitudes (De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009; Gawronski, Hofmann, & Wilbur, 2006), and self-concept (e.g., Back, Schmukle, & Egloff, 2009; Egloff & Schmukle, 2002; Schmukle, Back, & Egloff, 2008; Schnabel, Banse, & Asendorpf, 2006). It involves switching between an attribute task and a categorization task. Each task has its own categorizations, e.g., FLOWERS, INSECTS, GOOD and BAD and these categorizations are mapped to key presses such that the same keys are used in both tasks. In the compatible blocks, compatible categories are mapped to the same key (e.g., GOOD and FLOWERS are mapped to one key while BAD and INSECTS are mapped to the other key). In the incompatible blocks, incompatible categories are mapped to the same key (e.g., GOOD and INSECTS are mapped to one key while BAD and FLOWERS are mapped to the other key). The RT difference between the compatible block and the incompatible block is the IAT effect.

Participants in Sheppes et al.'s (2008) procedure switched between a self-reference evaluative task and a neutral task. The *self-reference* task was based on an IAT-variant developed by Karpinski and Steinman (2006). Participants were asked to categorize self-related stimuli (e.g., the participant's name) as well as negative and positive attributes using only two key presses. Critically, this resulted in two types of blocks: blocks in which the key indicating "self" was the same key indicating positive attributes (self=positive mapping), and blocks in which the key indicating "self" was the same key indicating negative attributes (self=negative mapping). In the *neutral* task, participants categorized shape stimuli (e.g., circle) as well as two attributes (dark and light color stimuli). Participants switched from the *self-reference* task to the *neutral* task every eight trials. The main result of this study concerned the size of the SC from the *self-reference* task to the *neutral* (shape-color) task as a function of whether the preceding self-reference task involved self-positive or self-negative association. Dysphoric and non-dysphoric individuals showed comparable SC in the self=positive mapping. However, in the self=negative mapping non-dysphorics showed higher SC. Importantly, the two groups showed comparable SC when switching from the *neutral* task to the *self-reference* task.

Three processes can be related to the increased SC: difficulties in engaging in the neutral task set, difficulties in disengaging from the self-reference task set, or difficulties in maintaining the self-reference task set. Because the heightened SC appeared following the self=negative mapping but not following the self=positive mapping, difficulties in engaging in the neutral task can be ruled out as an explanation of the "dysphoria effect". Therefore, Sheppes et al. (2008) concluded that this finding reflects the difficulties that non-dysphoric individuals have in maintaining a negative self-concept. This effect was later termed "negativity aversion" (Sheppes, Meiran, Spivak, & Shahar, 2010). Importantly, dysphoric individuals did not exhibit negativity aversion. We acknowledge the fact that Sheppes et al.'s results could logically reflect enhanced difficulties in disengaging from the *self-reference* task (in self=negative mapping) among non-dysphorics, unrelated to maintenance difficulties. The existing data cannot completely rule out this possibility. Specifically, it could be that staying in the self-reference task when the relevant mapping was self=negative was perceived by non-dysphorics as an impending source of threat, which encouraged them to keep attending to it, whereas dysphorics already saw themselves as negative.

Building on these findings, Sheppes et al. (2010) assessed negativity aversion, using the same TS paradigm, several months before an academic exam. Four weeks before the exam, participants rated their expected grade and completed the Beck Depression Inventory (BDI; Beck, Steer, & Brown, 1996). The BDI was administered once again several days after the exam in order to assess depressive responses, while taking into account the pre-exam scores. Participants were divided into two groups according to the discrepancies between their actual grade and their expected grade. The failure group included participants with grades lower than they expected, and the rest were in the non-failure group. The results showed that negativity aversion predicted a smaller depressive response in the academic failure group. That is, people who found it difficult to maintain a self-negative mindset were more likely to overcome the failure emotionally. In contrast, people who could maintain a self-negative mindset more easily maintained this mindset after failure, and felt depressed.

Importantly, in both of these studies, there was no difference between the dysphoric and non-dysphoric groups in the IAT effect. Both groups showed an IAT effect that reflected performance advantage to the self=positive mapping, presumably indicating positive self-evaluation in dysphoria, contrary to what would be expected. This result is similar to previous studies that used the IAT and found positive self-concept even among depressive individuals (e.g., De Raedt, Schacht, Franck, & De Houwer, 2006).

The two lines of research that we reviewed in this section show that SC-based measures provide new insights that, in some cases, run contrary to the current knowledge in their field. First, Sheppes et al.'s studies (2008, 2010) found evidence for negativity aversion among non-dysphoric individuals, in contrast to previous findings from the IAT literature that found a prevalent positive bias towards the self among both dysphoric as well as non-dysphoric individuals (e.g., De Raedt et al. 2006). It is worth noting that the SC results are congruent with the theoretical as well as clinical understanding of depression which argues for a negative self-concept in depression (e.g. Abramson, Metalsky, & Alloy, 1989; Beck, Epstein, & Harrison, 1983). This is not true for the IAT results (but see De Raedt et al., 2006; Franck, De Raedt, & De Houwer, 2008).

Second, Johnson's (2009) results indicate that anxious individuals exhibit difficulties in engaging in emotional processing, while other indirect measures such as the emotional spatial cuing paradigm yielded an association between anxiety and disengagement difficulties (Fox, Russo, Bowles, & Dutton, 2001). We return to this issue in the General Discussion.

4. *Studies focusing on the Task Rule Congruency Effect (TRCE)*

Sudevan and Taylor (1987) were the first to document TRCE. They asked participants to switch between categorization of digits according to one of two task rules: parity or numerical size. The participants indicated their responses with two response keys. For example (for some participants), the left key served to indicate that the digit was >5 when the task was Size and the same key served to indicate that the digit was odd when the task was Parity. The right key served to indicate that the digit was <5 or even, in the two tasks, respectively. This structure permits a comparison between congruent trials, in which both task rules required the same response key (e.g., the digit "7" indicating a left key press according to both tasks because it is both ODD and >5), and incongruent trials, in which the two task rules indicated conflicting key presses (e.g., the digit "8"). The RT advantage of congruent trials relative to incongruent trials is the TRCE (for review see Meiran & Kessler,

2008). TRCE, then, reflects the automatic processing of the currently irrelevant task rule, according to Bargh's (1989) and Tzelgov's (1997; see also Tzelgov & Ganor-Stern, 2005) definition of automaticity as processing taking place without monitoring and not as a part of the task's requirement. Below we describe several studies that utilize TRCE in order to measure automatic evaluation and evaluative personality processes.

The first tool that used the TRCE to measure automatic evaluation is the Extrinsic Affective Simon Task (EAST; De Houwer, 2003). In these studies, participants were asked to respond to white, green and blue words by pressing one of two keys. White words were categorized by valence so that one key was associated with POSITIVE while the other was associated with NEGATIVE. Green and blue words were categorized by their color using the same keys that were used to indicate POSITIVE and NEGATIVE. This design makes it possible to assess the automatic evaluation of stimuli, such as the participant's name, as positive or negative. The logic here is that if the automatic evaluation is positive, color responses would be quicker when they use the key that indicates POSITIVE. In TS-terms, the EAST involves switching between categorization of univalent stimuli according to *valence* or *color* task rules. We note that the stimuli were univalent in the sense that one set of stimuli was used for one task while the other set of stimuli was used in the other task. However, the stimuli in the color task could be classified according to valence, and in that sense they were partly bivalent.

Research used the EAST to assess attitudes towards the self (De Houwer, 2003), positive self-esteem in depressed individuals (De Raedt et al., 2006), attitudes towards food among children who suffer from obesity (Craeynest et al., 2005), and attitudes toward alcohol-related stimuli (De Houwer & De Bruycker, 2007a). However, De Houwer and De Bruycker (2007b) concluded that the IAT outperforms the EAST paradigm, mostly because it shows a much better reliability.

In a recent study, our group utilized the TRCE in order to study evaluative personality processes following schema activation in individuals with histrionic personality disorder (HPD) features (Rahamim, Meiran, Ostro, & Shahar, 2012). In two experiments, we asked participants to vividly recall an event in which they were given a warm hug from their parents and were told they are loved (intimacy induction), or an event in which they were traveling by bus and someone sat so close to them that there was physical contact with that person (control induction). Following the induction, participants were asked to perform a task switching paradigm. In Experiment 1, we asked participants to switch between classifying names of acquaintances according to gender and classifying adjectives according to valence. This paradigm is quite similar to the EAST in that the stimuli are univalent but the same set of response keys is used in the two tasks. However, an advantage of this paradigm relative to a standard EAST is that the non-evaluative task requires semantic processing rather than just perceptual processing (color; see the ID-EAST, De Houwer & De Bruycker, 2007a, for another EAST variant that requires semantic processing of all stimuli).

We then calculated TRCE separately for names of disliked acquaintances and liked acquaintances in the *gender* task (when valence was irrelevant), creating two TRCE measures. In a regression analysis, we found that following an intimacy induction, the level of HPD features was correlated with the size of the TRCE effect

for negative stimuli in the *gender* task. That is, individuals with elevated HPD features exhibited increased TRCE when the stimuli were names of disliked acquaintances but not when the stimuli were names of liked acquaintances. In order to amplify the TRCE, we dropped the adjective stimuli in Experiment 2 and asked the participants to perform both the *valence* and the *gender* tasks on the name stimuli. This modification resulted in larger TRCE effects. Additionally, Experiment 1's results were replicated albeit much more clearly. Another advantage of this design was the ability to calculate two additional equivalent TRCE measures (of liked and disliked acquaintances), this time computed in the *valence* task, indicating the automatic processing of gender information. These TRCE measures were unrelated to individual differences in personality. In this regard, the results of Experiment 2 indicate that the influence of HPD was specific to automatic negative evaluations. Our interpretation was that the intimacy induction activated maladaptive schema in individuals with HPD features because for them intimacy was experienced as an interpersonal threat. Such activation resulted in automatic negative evaluation of disliked persons as negative. Such automatic evaluation presumably helps in the quick detection of potential interpersonal threat.

So far we described possible examples for using TRCE as a measure of evaluation and evaluative personality processes. We now turn to detail, and discuss three main features of this paradigm: sensitivity, specificity, and non-relativity. *Sensitivity* refers to the ability to identify automatic processes even when automaticity is weak. Weak automatic processes occur when the process is irrelevant to the current task but is occasionally relevant to another task. It has been shown that automatic processing of irrelevant information increases, and thus detected more easily, when this information is occasionally relevant (e.g., Marble & Proctor, 2000; Meiran, 2005; Meiran, Cole, & Braver, 2012). TS paradigms require occasional execution of both tasks and thus provide a well suited platform for identification of weakly automatic behavioral effects.

Specificity refers to the ability to distinguish general automatic categorization from dimension-specific automatic categorization which is achieved by calculating TRCE measures for each of the tasks, separately. For instance, increased TRCE among individuals high in HPD could reflect a generally poorer cognitive control or increased automaticity of these individuals in comparison to non-HPDs. However, the fact that the TRCE in the valence task was not elevated helps ruling out these alternative accounts.

Let us consider the following example in order to capture the *non relativity* feature: A researcher is interested in studying participants' attitudes towards their caregivers- parents and teachers. Let us assume Person A holds a positive attitude toward his/her parents as well as his/her teachers, although his/her parents are preferred, while Person B holds positive attitudes towards his/her parents but negative attitude towards his/her teachers. For both persons, the association between "parents" and "positive" is stronger than the association between "teacher" and "positive", thus both are expected to show similar pattern of results in indirect measures that assess preference rather than evaluations of single objects. For instance, in the IAT, both persons are expected to show quicker responses in the blocks in which PARENTS and POSITIVE share one key while TEACHER and NEGATIVE share the other key than in blocks with the opposite mapping. However, the TRCE measure may overcome this relativity problem by calculating separate TRCE measures for TEACHERS and

PARENTS as Rahamim et al. (2012) did with respect to liked and disliked acquaintances. Thus, while Person A is expected to react faster to teachers as well as parents stimuli when those are mapped together with positive stimuli, Person B is expected to exhibit quicker responses to teachers when they are mapped with negative stimuli.

5. *General Discussion*

In this review, we suggested TS methodology as a platform for indirect measures of evaluative processes in the study of psychopathology, attitudes and personality processes. This proposed platform yields at least two classes of measures of individual differences- measures related to SC and measures related to TRCE. The SC-based measures include SC when switching from a neutral task to an emotional task (Johnson, 2009) and the SC when switching in the reverse direction (Sheppes et al., 2008, 2010). These SC measures could reflect the difficulty of engaging in the emotional/evaluative task and the difficulty of disengaging from (or maintaining of) that task, respectively. Up to four different TRCE-based measures can be used (Rahamim et al., 2012), reflecting the weak-automatic processing of the evaluative rule and the neutral rule for different types of stimuli. Although the exact processes that are involved in these measures are not fully understood, several findings indicate that these two effects represent distinct processes.

First, there is *no* overlap in the definition of these two effects: a switch/repeat trial can be either congruent or incongruent and vice versa. This is also true for the IAT effect, which is orthogonal to SC and TRCE because switch, repeat, congruent and incongruent trials are found both in the compatible-IAT blocks and the incompatible-IAT blocks. In other words, there is nothing in the *definition* of the IAT effect that would force it to correlate with SC and TRCE. This makes the correlation between these measures an empirical question rather than a definitional issue. Second, the interaction between SC and TRCE (in neutral tasks) is quite weak as compared with the overall congruency effect (an interaction of 21, 25 ms as compared to an overall effect of 65-113 ms, see e.g. Yehene & Meiran, 2007). Third, a double dissociation can be found between the two effects: TRCE can be seen in cases in which SC is absent (Dreisbach, Goschke, & Haider, 2007), or even in cases in which there is no task switching taking place at all, and there is just an unsuccessful implementation of the intention to switch tasks, such as following damage to the basal ganglia (Yehene, Meiran, & Soroker, 2005). Concomitantly, SC can be seen in cases in which TRCE is absent (Meiran & Kessler, 2008).

However, such dissociation does not imply that individual differences in one personality-related process (e.g. sensitivity to negative information) *cannot* result in an increase in both TRCE and SC or even in other indirect measures such as the IAT. To investigate that, it is essential to use a number of measures in the same study, a design that is not often used. Sheppes et al.'s (2008, 2010) studies constitute a rare example because they show, in the same experiment, that the SC measure and the IAT measure point to opposite conclusions, suggesting that they reflect distinct processes. Interestingly, this conclusion seemingly contrasts with Klauer and Mierke (2005, see also Klauer, Schmitz, Teige-Mocigemba, & Voss, 2010; Mierke & Klauer, 2001, 2003), who showed that a part of the IAT effect can be described as a task switching effect. These authors argued that during the compatible phase of the IAT task, participants can respond correctly in the categorization task without actually performing this task but instead, by performing the attribute task. Thus, correct responding can be achieved in the compatible blocks without actual task switching.

Such a strategy is not feasible during the incompatible phase. Thus, RT is arguably prolonged in the incompatible phase because of the need to switch between the attribute task and the categorization task, a switch that can be avoided in the compatible phase. Although Klauer and Mierke showed a connection between SC and the IAT effect, they concluded that SC explains the method variance rather than the attitude or personality trait that are being evaluated (Mierke & Klauer, 2003, see also Klauer et al., 2010).

We thus argue that Mierke and Klauer's (2005) account does not pertain to the SC in Sheppes et al.'s (2008) study for two main reasons. First, Mierke and Klauer speak of task switching that takes place (or could be avoided) within the IAT task whereas Sheppes et al. speak of the switch from the IAT task to the neutral task. This switch could not be avoided, at least not in the manner described by Mierke and Klauer. Second, Mierke and Klauer's hypothesis does not refer to switching in a specific content. Actually, these authors emphasize the fact that SC pertains to the method variance, not to the attitude variance. In contrast, Sheppes et al. showed that switching content was critical because SC was associated with lack of dysphoria only (a) when switching from the self task to the neutral task, and (b) only when the self task was self=negative.

Presently, the distinct processes involved in the different measures still remain undetermined, and more research is needed. We hypothesize that the critical element might be the involvement of the goal system and intention when the goals and intentions concern self-related and emotional content. Two lines of inquiry are relevant in this regard. First, Zelazo and Argitis's (2003) theory focuses on the ability to switch between two tasks. According to the theory, this ability reflects the formation of a high order conscious representation which integrates the two tasks. Before such a representation is formed, there is no way to relate one task to the other task. This high-order representation in turn allows task selection by means of assigning differential priorities to the tasks at hand. In fact, several current theories assume that task selection is accomplished in this manner (Gilbert & Shallice, 2002; Logan & Gordon, 2001; Meiran, Kessler, & Adi-Japha, 2008). Accordingly, we suggest that the goal system consists of a representation encompassing all the relevant goals as well as the attentional processes involved in the implementation of differential priorities.

The second line of inquiry concerns what Meiran et al. (2012) label "intention-based reflexivity". According to these authors, intention is represented in working memory, and this representation may result in the reflexive operation of this intention. Note that this form of reflexivity is distinguishable from other forms of automaticity because it reflects the side effect of the current intention and as such it requires intention. The TRCE could be seen as being influenced by intention-based reflexivity because it reflects the (possibly partial) operation of an intended rule in a moment when this intention is irrelevant. Specifically, when people are ready to perform one of two tasks (e.g., judge stimuli according to their color or valence), the intention of the irrelevant task (e.g., the operation of the *valence* rule when a *color* response is executed) is represented in the working memory, and its reflexive operation causes the TRCE. Therefore, TRCE reflects intention-based reflexivity.

These conceptions may allow us to differentiate between attitude/personality measures in the TS paradigm and other effects that are not by-products of current intention. For instance, it is possible that the IAT effect is not predominantly a side effect of the current intention but rather mostly reflects the presence of an association in long-term memory. For example, an IAT effect showing quicker responses when INSECT and BAD are mapped together and FLOWER and GOOD are mapped

together indicates the presence of these associations in long-term memory. In contrast, SC-based measures may be used to assess the difficulty of engaging in the intention to execute an emotional task (Johnson, 2009). Additionally, SC-based measures assess the difficulty holding an intention to execute an evaluative self-related task (Sheppes et al., 2008, 2010). Concomitantly, TRCE-based measures assess the reflexivity which results from the current intention, and thus reflect the intention *in the current situation*. In this regard, Rahamim et al.'s (2012) finding reflects the heightened intention *in the current situation* to detect the negative aspects in persons.

The relevance of such a goal system feature to personality processes assessment is depicted by Mischel and Shoda's (1995) Cognitive Affective Personality System (CAPS) model (see also McConnell, 2011). According to CAPS, the cognitive-affective unit of goals together with the units of encoding, expectancies and beliefs, affects, competencies and self-regulation, construe the personality mediating system. Karoly (1999) further suggested that relatively to the other units, goals and self-regulation are pivotal to personality:

"...goals and self-regulatory skills are at the core of people's if-then, situation-behavior profiles and that the other elements in CAPS are better viewed as subsidiary. In fact, to the extent that goals provide the operational fulcrum for self regulatory guidance...they deserve to stand alone at the generative center of CAPS." (Karoly, 1999, p. 268).

We therefore suggest that because TS allows access to the pivotal unit of goals, the measures yielded from it (SC, TRCE) allow the assessment of processes of personality that could not otherwise be evaluated in many of the currently used indirect measures. We hope that the current review will stimulate additional research in this direction as much still remains to be uncovered.

6. References

Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). Hopelessness depression: A theory-based subtype of depression. *Psychological Review*, *96*(2), 358-372.

Allport, D. A., Styles, E. A., & Hsieh, S. (1994). Shifting intentional set: Exploring the dynamic control of tasks. In M. Moscovitch & C. Umiltà (Eds.), *Attention and performance XVIII: Conscious and nonconscious information processing* (pp. 421–452). Cambridge, MA, US: The MIT Press.

Back, M. D., Schmukle, S. C., & Egloff, B. (2009). Predicting actual behavior from the explicit and implicit self-concept of personality. *Journal of Personality and Social Psychology*, *97*(3), 533-548.

Bargh, J. A. (1989). Conditional automaticity: Varieties of automatic influence in social perception and cognition. In J. S. Uleman & J. A. Bargh (Eds.), *Unintended thought*. (pp. 3–51). New York, NY, US: Guilford Press.

Beck, A. T., Epstein, N., & Harrison, R. (1983). Cognitions, attitudes and personality dimensions in depression. *British Journal of Cognitive Psychotherapy*, *1*, 1–16.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for beck depression inventory II (BDI-II)*. San Antonio, TX: Psychology Corporation.

Cepeda, N. J., Cepeda, M. L., & Kramer, A. F. (2000). Task switching and attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology*, *28*(3), 213–226.

Craeynest, M., Crombez, G., De Houwer, J., Deforche, B., Tanghe, A., & Bourdeaudhuij, I. D. (2005). Explicit and implicit attitudes towards food and physical activity in childhood obesity. *Behaviour Research and Therapy*, *43*(9), 1111–1120.

De Houwer, J. (2003). The Extrinsic Affective Simon Task. *Experimental Psychology (formerly "Zeitschrift für Experimentelle Psychologie")*, *50*(2), 77–85.

De Houwer, J. (2009). How do people evaluate objects? A brief review. *Social and Personality Psychology Compass*, *3*(1), 36–48.

De Houwer, J., & De Bruycker, E. (2007a). The identification-EAST as a valid measure of implicit attitudes toward alcohol-related stimuli. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*(2), 133–143.

De Houwer, J., & De Bruycker, E. (2007b). The implicit association test outperforms the extrinsic affective Simon task as an implicit measure of inter-individual differences in attitudes. *British Journal of Social Psychology*, *46*(2), 401–421.

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin*, *135*(3), 347–368.

De Raedt, R., Schacht, R., Franck, E., & De Houwer, J. (2006). Self-esteem and depression revisited: Implicit positive self-esteem in depressed patients? *Behaviour Research and Therapy*, *44*(7), 1017–1028.

Dreisbach, G., Goschke, T., & Haider, H. (2007). The role of task rules and stimulus–response mappings in the task switching paradigm. *Psychological Research*, *71*(4), 383–392.

Eagly, A. H., & Chaiken, S. (1998). Attitude structure and function. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., Vol. 1–2, pp. 269–322). New York, NY, US: McGraw-Hill.

Egloff, B., & Schmukle, S. C. (2002). Predictive validity of an Implicit Association Test for assessing anxiety. *Journal of Personality and Social Psychology*, *83*(6), 1441–1455.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General*, *130*(4), 681–700.

Franck, E., De Raedt, R., & De Houwer, J. (2008). Activation of latent self-schemas as a cognitive vulnerability factor for depression: The potential role of implicit self-esteem. *Cognition and Emotion*, *22*(8), 1588–1599.

Gawronski, B., & De Houwer, J. (In press). Implicit measures in social and personality psychology. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (2nd edition). New York: Cambridge University Press.

Gawronski, B., Hofmann, W., & Wilbur, C. J. (2006). Are “implicit” attitudes unconscious? *Consciousness and Cognition*, *15*(3), 485–499.

Gibson, J. J. (1941). A critical review of the concept of set in contemporary experimental psychology. *Psychological Bulletin*, *38*(9), 781–817.

Gilbert, S. J., & Shallice, T. (2002). Task switching: A PDP model. *Cognitive Psychology*, *44*(3), 297–337.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, *102*(1), 4–27.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*(6), 1464–1480.

Jersild, A. T. (1927). Mental set and shift. *Archives of Psychology*, *14*(89), 81.

Johnson, D. R. (2009). Emotional attention set-shifting and its relationship to anxiety and emotion regulation. *Emotion*, *9*(5), 681–690.

Karoly, P. (1999). A goal systems–self-regulatory perspective on personality, psychopathology, and change. *Review of General Psychology*, *3*(4), 264–291.

Karpinski, A., & Steinman, R. B. (2006). The Single Category Implicit Association Test as a measure of implicit social cognition. *Journal of Personality and Social Psychology*, *91*(1), 16–32.

Kiesel, A., Steinhauser, M., Wendt, M., Falkenstein, M., Jost, K., Philipp, A. M., &

- Klauer, K. C., & Mierke, J. (2005). Task-set inertia, attitude accessibility, and compatibility-order effects: New evidence for a task-set switching account of the Implicit Association Test effect. *Personality and Social Psychology Bulletin*, *31*(2), 208–217.
- Klauer, K. C., Schmitz, F., Teige-Mocigemba, S., & Voss, A. (2010). Understanding the role of executive control in the Implicit Association Test: Why flexible people have small IAT effects. *The Quarterly Journal of Experimental Psychology*, *63*(3), 595–619.
- Koch, I. (2010). Control and interference in task switching-A review. *Psychological Bulletin*, *136*(5), 849–874.
- Koch, I., Gade, M., Schuch, S., & Philipp, A. M. (2010). The role of inhibition in task switching: A review. *Psychonomic Bulletin & Review*, *17*(1), 1–14.
- Logan, G. D., & Gordon, R. D. (2001). Executive control of visual attention in dual-task situations. *Psychological review*, *108*(2), 393-434.
- Marble, J. G., & Proctor, R. W. (2000). Mixing location-relevant and location-irrelevant choice-reaction tasks: Influences of location mapping on the Simon effect. *Journal of Experimental Psychology: Human Perception and Performance*, *26*(5), 1515-1533.
- McConnell, A. R. (2011). The multiple self-aspects framework: Self-concept representation and Its implications. *Personality and Social Psychology Review*, *15*(1), 3–27.
- Meiran, N. (1996). Reconfiguration of processing mode prior to task performance. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*(6), 1423-1442.
- Meiran, N. (2005). Task rule-congruency and Simon-like effects in switching between spatial tasks. *The Quarterly Journal of Experimental Psychology Section A*, *58*(6), 1023–1041.
- Meiran, N. (2010). Task switching: Mechanisms underlying rigid vs. flexible self-control. In R. R. Hassin, K. N. Ochsner, & Y. Trope (Eds.), *Self control in society, mind, and brain*, Oxford series in social cognition and social neuroscience. (pp. 202–220). New York, NY, US: Oxford University Press.
- Meiran, N., Cole, M. W., & Braver, T. S. (2012). When planning results in loss of control: intention-based reflexivity and working-memory. *Frontiers in Human Neuroscience*, *6*.
- Meiran, N., & Kessler, Y. (2008). The task rule congruency effect in task switching reflects activated long-term memory. *Journal of Experimental Psychology: Human Perception and Performance*, *34*(1), 137-157.
- Meiran, N., Kessler, Y., & Adi-Japha, E. (2008). Control by action representation and input selection (CARIS): A theoretical framework for task switching. *Psychological Research*, *72*(5), 473–500.

- Meiran, N., Levine, J., Meiran, N., & Henik, A. (2000). Task set switching in schizophrenia. *Neuropsychology*, *14*(3), 471-482.
- Mierke, J., & Klauer, K. C. (2001). Implicit association measurement with the IAT: Evidence for effects of executive control processes. *Experimental Psychology (formerly "Zeitschrift für Experimentelle Psychologie")*, *48*(2), 107-122.
- Mierke, J., & Klauer, K. C. (2003). Method-specific variance in the implicit association test. *Journal of Personality and Social Psychology*, *85*(6), 1180-1192.
- Mischel, W., & Shoda, Y. (1995). A cognitive-affective system theory of personality: reconceptualizing situations, dispositions, dynamics, and invariance in personality structure. *Psychological Review*, *102*(2), 246-268.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "Frontal Lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49-100.
- Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, *84*(3), 231-259.
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*(3), 385-401.
- Rahamim, O., Meiran, N., Ostro, S., & Shahar, G. (2012). Individuals with histrionic personality disorder features categorize disliked persons as negative following intimacy induction: A state trait interaction analysis. *Personality and Individual Differences*, *52*(7), 788-793.
- Rogers, R. D., & Monsell, S. (1995). Costs of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology: General*, *124*(2), 207-231.
- Schmukle, S. C., Back, M. D., & Egloff, B. (2008). Validity of the five-factor model for the implicit self-concept of personality. *European Journal of Psychological Assessment*, *24*(4), 263-272.
- Schnabel, K., Banse, R., & Asendorpf, J. B. (2006). Assessment of implicit personality self-concept using the implicit association test (IAT): Concurrent assessment of anxiousness and anger. *British Journal of Social Psychology*, *45*(2), 373-396.
- Schuch, S., Werheid, K., & Koch, I. (2012). Flexible and inflexible task sets: Asymmetric interference when switching between emotional expression, sex, and age classification of perceived faces. *Quarterly Journal of Experimental Psychology*, *65*(5), 994-1005.
- Shaffer, L. H. (1965). Choice reaction with variable SR mapping. *Journal of Experimental Psychology*, *70*(3), 284-288.
- Shallice, T., Stuss, D. T., Picton, T. W., Alexander, M. P., & Gillingham, S. (2008). Mapping task switching in frontal cortex through neuropsychological group studies. *Frontiers in Neuroscience*, *2*(1), 79-85.

Sheppes, G., Meiran, N., Gilboa-Schechtman, E., & Shahar, G. (2008). Cognitive mechanisms underlying implicit negative self concept in dysphoria. *Emotion*, 8(3), 386-394.

Sheppes, G., Meiran, N., Spivak, O., & Shahar, G. (2010). An indirect measure of negative self reference interacts with academic failure to predict continuing depressive symptomatology. *Journal of Research in Personality*, 44(5), 602–609.

Sudevan, P., & Taylor, D. A. (1987). The cuing and priming of cognitive operations. *Journal of Experimental Psychology: Human Perception and Performance*, 13(1), 89-103.

Tzelgov, J. (1997). NOTE. *Consciousness and Cognition*, 6(2–3), 441–451.

Tzelgov, J., & Ganor-Stern, D. (2005). Automaticity in processing ordinal information. *Handbook of mathematical cognition*. (pp. 55–66). New York, NY, US: Psychology Press.

Vandierendonck, A., Liefoghe, B., & Verbruggen, F. (2010). Task switching: Interplay of reconfiguration and interference control. *Psychological Bulletin*, 136(4), 601–626.

Yehene, E., & Meiran, N. (2007). Is there a general task switching ability? *Acta Psychologica*, 126(3), 169–195.

Yehene, E., Meiran, N., & Soroker, N. (2005). Task alternation cost without task alternation: Measuring intentionality. *Neuropsychologia*, 43(13), 1858–1869.

Zelazo, P. D., & Argitis, G. (2003). *The Development of executive function in early childhood*. Wiley-Blackwell.

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