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When Affect Supports Cognitive Control – A Working Memory Perspective

Abstract*: The paper delineates a study of executive functions (EFs), construed as procedural working memory (WM), from a motivational perspective. Since WM theories and motivation theories are both concerned with purposive activity, the role of implicit evaluations (affects) observed in goal pursuit can be anticipated to arise also in the context of cognitive control, e.g., during the performance of the Stroop task. The role of positive and negative affect in goal pursuit consists in controlling attention resources according to the goal and situational requirements. Positive affect serves to maintain goals and means in the scope of attention (EF1), whereas negative affect activates the inhibition of non-functional contents, e.g., distractors and irrelevant objects (resulting in attention disengagement; EF2). Adaptation to conflict proceeds via sequential triggering of negative and positive affect (EF3). Moreover, it was demonstrated that the focus on action or reflection changes the scope of contents subjected to implicit (affective) control. Therefore, I suggest that the motivational system, to a large extent, plays the role of the Central Executive. The paper opens a discussion and proposes studies on affective mechanisms of cognitive control.*

Key words*: executive functions, affect, purposive activity, working memory*

The significance of working memory was discovered less than fifty years ago (Nęcka, 2009) as the understanding of how purposive actions can be controlled emerged, driven by advances in the field of cybernetics (Miller, Galanter & Pribram, 1960). The studies of the frontal lobe led Miller to describe "operating memory" functions associated with maintaining and carrying out a plan when faced with obstacles or an unexpected change of situation (Nęcka, 2009). Short-term information storage and its simultaneous handling (attributed to purposive activity) also characterize working memory (WM) in the classical Baddeley & Hitch model (1974). However, Oberauer (2010) observed that researchers tend to focus only on one of the aspects of WM – either on the storage component, i.e., people's ability to recall or recognize items after short retention intervals (mostly in WM capacity studies), or on the information processing component ("selection and control of actions in simple choice situations, dual-task constellations, or task-switching setups;" Oberauer, 2010, p. 277). This may be an effect of how short-term memory (STM), which is free from the procedural aspect, has traditionally been studied.

In my understanding, the natural drive to integrate both WM research perspectives stems from the conviction that goal attainment depends on the flexible use of various pieces of information, organized in the framework of a functionally coherent structure (WM). It is precisely this perspective that Oberauer proposes for the integration of the "storage" and "processing" aspects of working memory (2010, p. 278). At the same time, he develops Cowan's ideas (1999), according to which WM is responsible for the activation and attentional availability of information necessary for the execution of current goals and tasks. Oberauer goes as far as to border on paradox, claiming that WM is not in fact memory *per se*, but rather a system of attention, understood as "any mechanism or process that prioritizes a subset of representations over others, thus giving the selected set of representations a larger influence on further cognitive processes" (Oberauer, 2010, p. 278). Engle (2002) arrived at similar conclusions in his studies on the relationship between working memory capacity (WMC) and fluid intelligence. He concluded that WMC is only indirectly related to memory, as higher WMC means

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a larger number of items can temporarily be activated, owing to control processes, including avoiding distractors. People with higher WMC are better equipped to cope with tasks requiring response inhibition, such as the Stroop task (the inhibition of response to the meaning of a word, when the color of the lettering is to be named instead), particularly when the goal was only weakly supported by the environment (when only a small percentage of trials were incongruent; Kane and Engle, 2003).

Oberauer's (2010) and Engle's (2002) studies appear to indirectly support the thesis that short-term information storage proceeds differently when it serves a subject's goal (thus involving evaluation) compared to storing items in WM that represent neutral content. Both types of information, affective and neutral, may engage WM resources, even though this results from different handling of its items, as demonstrated by studies in which participants' feelings were measured in response to photographs categorized as neutral, positive or negative. The increasing complexity of tasks was meant to be the factor restricting WMC. The introduction of difficult tasks reduced the degree to which neutral and negative states, but not positive states, were experienced. Both negative and neutral states "possess felt intensity and require cognitive resources to be maintained" (Gasper & Hackenbracht, 2015, p. 458). The lack of interference between positive experiences and solving a difficult task could be attributed to functional relationships between the two rather than to positive experiences not using WM resources. According to the studies discussed below, positive affect associated with a goal enables its execution (Custers & Aarts, 2005). Therefore, additionally induced positive affect supports task solving without taking up additional resources.

With the above in mind, we can assume that there exist two fundamental reasons for the formation of working memory. The first one is motivational and is related to implementing and sustaining goal-directed activity. The other is cognitive and is associated with buffering, i.e., the temporary maintenance and extraction of complex semantic structures from a background of superfluous data (contained in LTM or registered perceptually) and keeping them accessible in spite of conflicts (Nęcka, 2009). Meanwhile, WM models are usually limited to the description of cognitive, diagnostic features. Affective processes in working memory can be studied using Cowan's and Oberauer's modern concepts, according to which at every stage of processing, memory traces are activated in accordance with situational demands; this triggers their transfer from LTM to WM, and up to the focus of attention, whose capacity is strictly limited (also cf. Nęcka, Orzechowski and Szymura, 2006). The contents requiring control are brought to attention and become conscious. Goals, owing to their motivational and causative aspect, occupy a singular place amongst the representations activated in WM. Engaging goal-dependent attention is strictly related to the evaluation of events, which takes place both in the case of emotions (e.g., Franken, 2005; Brosch, Scherer, Grandjean, Sander, 2013), as well as short-term, barely experienced affects (Roskos-Ewoldsen & Fazio, 1992), although neither Oberauer nor Cowan paid them much heed. Contents of different subjective value (related to goals and regulatory standards) compete for access to attention, thus determining the main current of human perception and thinking. To a large extent, thinking is a game aimed at making accessible to attention precisely those long-term memory contents and perceptual data, which are significant in the context of the current task and require cognitive control (i.e., are incoherent, unclear, strategically significant, demand response, etc.). As will be subsequently demonstrated, the nature of signals for such changes is usually that of negative or positive affect, directing mental activity.

There was never any doubt about the participation of affective processes (emotions, subtle but long-lasting moods and short-lasting affects) in controlling purposive actions. These were studied in the context of psychology of motivation, artificially separated from cognitive psychology. Meanwhile, cognitive control, also known as executive control, is "the instrument of volition" (Logan, 2004, p. 218), "enabling people to program and execute their actions in a manner appropriate to the context" (Nęcka, Lech, Sobczyk, & Śmieja, 2012, p. 240). Affective and cognitive functions, even though studied separately, determine control processes in tandem. Emotions are responsible, for instance, for the occurrence of motivational tension, modulating the willingness to involve oneself in goals, determining which goals, along with associated content, are activated in working memory, or which content needs to be inhibited as irrelevant. Experimental results on the role of affect in cognitive processes lead to the patching of cognitive control approaches with individual observations (e.g., Glasler & Banaji, 1999; Kolańczyk & Pawłowska-Fusiara, 2002; Raymond, Fenske, & Westoby, 2005; Jefferies, Smilek, Eich & Enns, 2008; Huntsinger, Isbell, & Clore, 2014; Gotoh, Kikuchi, & Olofsson, 2010; Gasper & Hackenbracht, 2015; Schouppe et al., 2015) or collections of observations (Locke & Braver, 2008; Piotrowski & Wierzchoń, 2009). The critical mass of insight from such studies, carried out also in this laboratory, allows me to attempt to extend the concept of working memory with the most significant affective mechanisms supporting cognitive control.

Affective-cognitive Mechanisms of Executive Functions

Working memory encompasses processes of particular evolutionary advancement, which deal with evaluating and selecting information, with the aim of attaining goals in the context of other tasks and diverse environmental conditions. These are known as executive functions (EF), and their exact number has not been agreed on (Smith & Kosslyn, 2009). Reviews by various authors (e.g., Miyake et al., 2000; Oberauer, 2010; Nęcka et al., 2012; Cohen, Aston-Jones & Gilzenrat, 2004) demonstrate that executive function can be understood either as a control mechanism, for instance, detecting and monitoring conflicts (e.g., Cohen et al., 2004), or as processes which directly

change the processing of information, such as inhibition (a consequence of response to conflict). The latter approach is adopted by Oberauer (2010), for whom EFs signify "the collection of cognitive functions or processes that serve to control the primary processes directed at solving a task" (p. 298). Oberauer enumerates the following types of EFs: 1) "storage" – establishing new structures in WM, e.g., encoding a new list; 2) „inhibition" – purging WM of content that is no longer relevant, e.g., following switching to a new task (in the aspect of declarative and procedural WM, this is a result of another type of conflict: the occurrence of distractors or competing responses); 3) „updating" – actively maintaining representations in WM when they are at risk of being lost (op.cit., p. 298).

The motivational significance of affect in instigating control processes is best understood in the context of EF mechanisms. Therefore, in my analyses and studies I will refer to the index of executive functions elaborated by Cohen, Aston-Jones and Gilzenrat (2004), with an awareness that the explored territory is incomplete. Apart from maintaining and updating goals (formulated by many authors), Cohen et al. also mention conflict detection and monitoring (e.g., activating distinct responses to the same stimulus, like colored lettering in the Stroop task), as well as control micro-adjustment for repetitive task requirements (e.g., the decrease in response time in the case of incongruence between word color and meaning in the Stroop task for subsequent incongruent trials). The choice of these particular EFs was dictated by their suitability for the scope of our empirical studies considering the role of affect, as well as by the applicability of experimental results on the resource consumption associated with these EFs (Unsworth, Redick, Spillers & Brewer, 2012) to explaining the role of affective operations. These studies will be discussed later.

According to contemporary WM theories (Baddeley & Logie, 1999; Cowan, 1999), executive functions (EFs) constitute one system, the central executive (CE). It is understood in similar terms to the supervisory attentional system (SAS; Norman & Shallice, 1986), which is known to be activated during novel, decision-related situations, when it becomes necessary to inhibit competing responses or recognized contents. In Engle's terms, controlled attention is the functional equivalent of CE (Engle & Kane, 2004; also cf. Piotrowski, Settner, Orzechowski & Balas, 2009), while in Posner's – it corresponds to executive attention, i.e., a system comprising the anterior cingulate cortex (ACC), prefrontal cortex (PFC), and the affective limbic system (Posner & Fan, 2008). However, is this additional *homunculus* encompassing EFs, such as the central executive, really necessary? An attempt to understand the significance of a central, or supervisory, system (its *homunculus* nature), so strongly related to the attention content management, led me to believe that it is mostly comprised of motivational structure, i.e., regulatory standards and values, as well as the associated, currently undertaken goals, which constitute the evaluation criteria for both the diagnosed reality and available responses. As a consequence of this assessment, affect is activated, subsequently controlling mental operations. In what follows I shall explain and provide empirical premises for this thesis. At the same time, I will discuss the contribution of affect to maintaining goals and the means (EF1), as well as in conflict monitoring and restricting the access of distractors and irrelevant stimuli (EF2). Moreover, I will present studies on the role of affect in sequential conflict adjustment (EF3). The paper ends with a presentation of studies aimed at extending the perspective of motivational structure with regulatory standards as determinants of action/promotion and reflection/prevention mindsets, highlighting the significance of EF1 and EF2 (with affect contribution) in each of the mindsets.

Sources of Affective Control over Attention, or How Motivational Processes Supplant the Central Executive

Goal-accomplishing motivational structure has the potential to perform executive functions, owing to how it is activated and the controlling function of affects. Here, goals are synonymous with representations of future states of affairs characterized by value (affective significance) and their potential to induce intentions. Whereas, regulatory standards, sometimes conflated with general goals, determine the scope of the desired functioning of a subject with regard to multiple goals, generating regulatory focus (Kolańczyk, 2001, 2014). These standards determine, among other things, the scope of acceptable achievements, performed obligations or ideals (Higgins, 1997). Standards, goals, and means constitute an associative system, which may be activated in WM according to rules laid out by Cowan and Oberauer. In accordance with the rule of spreading activation, by activating a goal, we activate the means of achieving it as well. The relation is reciprocal, i.e., the means may also activate the goal. Therefore, it is not necessary to engage attention resources for the activation of goals and means in WM to occur, as demonstrated by the effortless activation of behaviors (a phenomenon known as "automatic will"; Bargh, Gollwitzer, Lee-Chai, Barndollar & Troetschel, 2001; Kruglanski et al., 2002).

The distinguishing feature of a goal system, which is a consequence of evaluation, is its activation potential, which can augment possible incompatible responses with the conflict of goal pursuits (Kruglanski et al., 2012, 2014). However, Kruglanski and coworkers were the first to demonstrate that in the presence of strong motivation the main goal is shielded by "automatic", i.e., unconscious, inhibition of temptations. For instance, in one of the experiments, the activation of the goal "maintaining a relationship with a girl" inhibited responses (prolonged RT for lexical decisions) to "pornographic movies" (Fishbach, Friedman & Kruglanski, 2003). Moreover, studies on individuals highly motivated to lead a healthy lifestyle (called dieters) have shown that inhibition occurs due to negative affect (Fishbach & Shah, 2006). The participants were asked to classify words associated with high-calorie food or fitness through pushing or pulling

a lever. It is known that pulling correlates with positive affect, while pushing – with negative affect (Chen & Bargh, 1999). Compared to non-dieters, dieters were faster in pushing the lever in response to words associated with food and in pulling it when classifying words associated with fitness. This indicates stronger negative affect towards high-calorie food and stronger positive one towards physical exercise. Due to this positive-negative asymmetry, control over engaging in particular goals can ensue. The scope of such implicit control of temptations is, however, limited primarily to goals accomplished obsessively and remaining in chronic conflict with other goals and tasks (Bélanger, Lafrenière, Vallerand & Kruglanski, 2013).

To sum up, when two goals conflict and one of them is a temptation (i.e., a distractor), effective conflict monitoring and response inhibition take place unwittingly, through negative affect.[1] In this respect, it is similar to the conflict in the flanker task. The task involves the visual cues guiding the participants in their search for the stimulus – either towards its actual or only its apparent location (a type of anti-saccade task). The cues automatically generate a "temptation" to respond against the goal, if the suggested direction is not consistent with the actual location of the stimulus. The difference in experimental conditions is as follows – in tasks measuring cognitive control there is no explicit relationship with the subject's motivational system, and the "temptation" does not ensue from the goal, but from automatic reaction to the stimulus. Even then, the activation of goals and related responses can also become automated and may be triggered by an associated stimulus (Shah & Kruglanski, 2003), which serves to offset these differences. For instance, a drug addict seeing a needle may experience a sudden need to inject the drug (Berridge & Aldridge, 2008).

There are indications that the nature of conflict monitoring depends on the level of activation, which brings the representation of goals, means and their relationships into the focus of attention. Relatively intense activation, which ensures that attention is engaged, gradually transforms cognition into metacognition (Cleermans & Jiménez, 2002; Pasquali, Timmermans, Cleeremans, 2010). Once metacognition is activated, executive processes may become complicated by the inclusion of self-control, dependent on "higher-order mental representations" that represent oneself as being in particular mental states (Lau & Rosenthal, 2011). This can happen, for instance, when the values of conflictual goals and the means linked to them are similar (e.g., passing a biology exam and taking part in dance workshops). In such cases, self-control takes the form of a distinctive purposive activity, enabling decision-making. If the Stroop task is used as an example, RTs indicating facilitation (lettering color congruent with meaning) and interference (when incongruent) are manifestations of low-order control. Experiencing difficulties when responding to incongruent stimuli and implementing a strategy of squinting to avoid the perception of meaning, exemplify metacognition that facilitates self-control. Thus it is necessary to differentiate between lower-order control and self-control. The studies of individual differences indicated that working memory capacity supports both of these processes. An example can be the implicit inhibition of the color of lettering in the Stroop task (Kane and Engle, 2003) vs. the explicit suppression of thoughts in Wegner's "White Bear" paradigm (Brewin and Beaton, 2002). Participants who scored high (vs. low) on WMC tasks were more effective in both cases of control (Broadway, Redick and Engle, 2010). These observations, however, only initiate research on low-order control vs. self-control in WM. In this work I try to verify the hypothesis that processes of cognitive control can be motivated implicitly. These are the lower-order control, available to metacognition in the form of sensations and gut feelings (intuition), therefore requiring fewer WM resources than self-control (Barrett, Tugade, & Engle, 2004).

This paper is devoted to proving empirically that executive functions (EFs) depend on implicit evaluations based on standards, goals and plans that constitute evaluation criteria. Implicit evaluations constitute the core of affects, elementary evaluations and barely conscious bias towards various objects (e.g., towards insects or flowers, as in the popular Implicit Association Test). A relatively constant activation of positive or negative affect by a particular object constitutes an attitude, e.g., to a rainbow. In order to comprehend the role of affect in purposive activity it is crucial to differentiate between affect understood as attitude and affect activated by the current evaluation of a goal and objects functionally related to it. For instance, leeches, normally perceived as disgusting, become a source of positive affect when used to treat a sick relative or friend, temporarily moderating the negative attitude towards the parasite to a milder one. The fact that affect is activated by goals is usually inferred based on implicit evaluations measured twice – before and after a task is concluded. This is achieved by a) comparing response times to positive or negative associations evoked by the studied object (affective priming procedure; Fazio, Sanbonmatsu, Powell, & Kardes, 1986); b) assessing negative vs. positive feelings in response to the measured prime stimuli (the affect misattribution procedure, Murphy & Zajonc, 1993); or c) patterns of facial muscle activity measured by EMG, typical for positive and negative affects (Niedenthal et al., 2009).

The Role of Positive Affect in Maintaining Goals (EF1)

Commitment to a goal becomes possible following its acceptance and the appearance of positive affect. The motivational role of positive affect is similar to that of positive emotions; however, it operates on a more molecular level (cf. Kolańczyk, 2014). For instance,

[1] Jasinska (2013), reviewing the neuroscience-based accounts of inhibitory control mechanisms in the human brain (e.g., Mostofsky & Simmonds, 2008; Munakata et al., 2011), also concluded that response inhibition is not a control (deliberate, effortful) process "by default", since "response inhibition can itself be a prepotent response tendency," as well as due to the fact that response inhibition processes may be stimulus-driven.

people shown photographs of faces expressing happiness (even if subliminally), drank twice as much liquids when thirsty (Winkielman, Berridge & Wilbarger, 2005). Positive affect constitutes a particularly significant condition for maintaining a goal during its direct implementation. The pairing of a goal with negative affect weakens determination, triggers the nonconscious cessation of goal pursuit (Aarts, Custers & Holland, 2007).

A number of studies have demonstrated that the selected goal is automatically marked with positive affect, acting as an implicit motivator (Custers & Aarts, 2005; Ferguson, 2008). The discovery that contents associated with a goal become more accessible to working memory, and, via positive affect, engage attention more easily, gains significance in the EF1 perspective (maintaining a goal). This increase of accessibility of goal-related contents has been termed a commitment marker (Goshke & Kuhl, 1993). The more motivated a person is, the more pronounced the influence of positive affect (Förster, Liberman & Higgins, 2005). There is also sufficient evidence for more positive implicit evaluations of means associated with the active goal (cf. Fishbach, Shah & Kruglanski, 2004; Ferguson, 2008; Kolańczyk, 2008). Crucially, once a goal is achieved, both the goal itself and the means are neutralized (Ferguson & Bargh, 2004). This was, for instance, inferred from an experiment, in which participants aimed to build words from scattered letters (anagrams). Compared were the implicit evaluations of stimuli related to the task (such as: noun, winning, game) between participants from a group who accomplished the task, and those who were told they are merely taking a break from work. The task-related contents were valuated only in the group that had not finished the task.

From the neuropsychological point of view, a goal is maintained with the aid of a reverberatory loop (Baver, Bargh & Cohen, 2002). Information about the goal is maintained in the prefrontal cortex in the form of activity patterns, which control the processes in WM. The cited studies on the role of affect suggest that it is owing to positive evaluation that goals can re-access the foci of attention. Incidentally, goals activated unconsciously obtain the same share of attention as goals established explicitly, "hijacking" control in order to be achieved, consequently impairing performance on an unrelated task relying on executive control (Marien et al., 2012, p. 399).

The highest consumption of WM resources was observed when goals were "personally rewarding" (Chiew & Braver, 2011). Neuropsychological studies have demonstrated that the subcortical reward system (which aims to evaluate the rewarding value of goals, and is thus related to triggering positive affect), maintains goals in the focus of attention through projections towards the prefrontal cortex (Wallis & Kennerley, 2010). These observations are in line with the results of studies, in which the pairing of a goal with positive affect increased determination (more effort was put into acting), as well as making purposive activity more flexible (Marien, Aarts & Custers, 2012). In this case, a significant role was likely played by the dopaminergic reward system, which broadens the focus of attention and facilitates flexible searching.

The pairing of goals and means with positive affect takes place automatically, the affect becoming, in fact, their attribute, as soon as they are activated. Even then, I classified this mechanism as EF1 due to the actual role of positive affect in maintaining goals and claiming the resources of WM and attention for their purposes. Of course, responding to distractors and other obstacles are also necessary for sustaining goal pursuit. This process can be facilitated by arousing negative affect, with the associated inhibition of access to attention.

The Role of Negative Affect in Conflict-Monitoring and Response Inhibition During Goal Pursuit (EF2)

Studies which have shown that contents unrelated to a goal may be evaluated negatively (devalued) pertained, for instance, to biological needs (eating, smoking etc.). Activating a focal need (e.g., to eat) made objects unrelated to that need (e.g., shampoo) less valuable (Brendl, Markman & Messner, 2003). It is thus non-functional objects, irrelevant for the goal, and even more so distractors, directly interfering with the target stimulus, that undergo devaluation. Such an effect was observed in the detection task, which consisted in finding a colorful pattern or a neutral face in a set of other patterns or faces (Raymond, Fenske & Westoby, 2005). Immediately after completing the task, the participants were asked to rank all objects that appeared during detection and to do it quickly, following their gut feeling. Distractors were given lower marks than the detected stimuli. The comparative effect itself may have resulted from a positive bias applied to the target stimulus. More importantly, however, distractors were ranked the lower the closer they were to the target object (i.e., the more they were deemed disruptive). Hence, it can be concluded that negative affect supports inhibiting contents that are irrelevant and interfere (are in conflict) with the purposive activity.

The thesis that the detection of cognitive conflict activates negative affect has in fact been known since Festinger (1957), and has been revived owing to the studies of Botvinick (2007) conducted in the context of cognitive control and brain activity. It is well-established that the anterior cingulate cortex (ACC) is responsible for conflict monitoring. It was also demonstrated that increased ACC activity is accompanied by negative affect (Critchley, 2005). Reasoning from these and similar studies, Botvinick (2007) concludes that the role of ACC consists not only in monitoring negative performance results (as has been believed so far), but in detecting aversive signals in general. Dreisbach & Fischer (2012) made the first step towards proving these assumptions true in relation to the Stroop task. By employing the affective priming procedure (Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Fazio, 2001), they demonstrated that incompatible stimuli (e.g., the word RED written in green lettering) activate negative affect. In the study, Stroop's colorful stimuli were first presented, followed by positive or negative words which were to

be classified accordingly. Incongruent stimuli triggered quicker responses to negative target words than to positive ones, which is interpreted by their activating negative affect and by affective congruence. The authors assumed after Botvinick that stimulus aversiveness is responsible for an increase in cognitive control. However, further research on the nature of this dependence is needed.

Fritz & Dreisbach (2015) continued their studies, employing a modified affective priming procedure, with the aim of tracking the dynamics of the changes of implicit evaluations for a range of expositions to colorful words and SOAs. In this way they determined time-frames for the activation of evaluations affectively congruent with priming. These were found to range between 200 to 400 ms, and with these parameters, incongruent stimuli were once again evaluated more negatively than the congruent stimuli (confirming the result of the study by Dreisbach & Fischer, 2012). Also confirmed were the basic findings regarding the optimum length of SOA in the affective priming paradigm. In the studies conducted to date (e.g., Fazio et al., 1986; Hermans, De Houwer & Eelen, 2001), the optimum level of SOA for assimilative evaluations (shorter RT following affectively congruent stimuli, longer RT following those affectively incongruent) ranged between 150 and 300 milliseconds. The value of SOA equal to 300 ms was used in a number of studies employing the affective priming paradigm (e.g., Ferguson & Bargh, 2004). More importantly, however, changes were observed in how Stroop's colorful words are evaluated as the exposition to stimuli and SOA are extended to 800 milliseconds. Fritz & Dreisbach (2015) claim that exposition to an incongruent stimulus that is sufficiently long to engage attention initiates counter-regulation, i.e., the change of stimulus valency, which facilitates conflict resolution.[2] However, it remains unknown why such a reversal of evaluations would be functional. Perhaps assuming a motivational perspective in explaining decisions would help clarify that.

Dreisbach & Fischer (2012), and subsequently Fritz & Dreisbach (2015) used only colorful congruent and incongruent words rather than the full Stroop task. Simple observation of stimuli activates the motivation for cognitive closure (Kruglanski & Webster, 1998) targeted at their identification. Meanwhile, the recognition of incongruent words causes difficulties due to the activation of incompatible identification cues. If these are accessible to a similar degree, colorful words may be recognized, for instance, as "oddities" (Bruner & Postman, 1949).[3] Another reason for the negativity of incongruent words could be processing disfluency. The fluency of information processing is known to be a source of positive affect, whereas the introduction of perceptive obstacles acts to offset this effect or can be a source of negative affect (Reber, Winkielman & Schwarz, 1998; Oppenheimer, 2008; Fritz & Dreisbach, 2013 & 2015). In such cases, the desire for stimulus recognition, and associated cognitive closure, becomes an implicit goal that is difficult to achieve. The studies cited earlier demonstrate that positive affect serves to maintain means to the goal in the focus of attention, even if the goal is implicit (Marien et al., 2012). Positive affect originating from engaging attention by an incongruent stimulus can serve to maintain it in the focus of attention until it is elaborated cognitively and identified.

In the actual Stroop task other motivational processes are at play. Here, the conflict concerns the incompatibility between the requirements dictated by the goal, e.g. read words, and the actual possibility of meeting these requirements in view of the automatically activated response to color. The target response to the content of a colorful word should activate positive affect, or otherwise it would not be implemented. The color of the word, on the other hand, constitutes a distractor and thus it should activate negative affect (Raymond, Fenske & Westoby, 2005; Fishbach & Shah, 2006). According to the classical explanation, the response to color is inhibited first. Once it is removed from the focus of attention, the target response, marked as positive, can be implemented. In the specific context of the Stroop task, this model remains to be verified directly. However, it is difficult to gauge differences in activated affects, when they stem from features corresponding to the same stimulus. More importantly, the study of implicit evaluations should take place after the participants are familiarized with the task, but before they complete it, so that the goal could shape the evaluation of stimuli. It is also possible to increase the accessibility of response to the word's color or meaning, and subsequently infer the affects from measurements of time intervals needed to react by pushing or pulling the lever (ongoing project). The studies of Dreisbach & Fischer (2012), and of Fritz & Dreisbach (2015) pave the way towards elucidation of this matter, and, more importantly, signal a paradigm shift, demonstrating how control processes and WM can be viewed from a motivational perspective.

The hypothesis on the inhibiting role of negative affect will be addressed again in the context of how goal attainment depends on the role of regulatory focus. In the meantime, I will proceed to analyze how affect participates in sequential conflict adjustment (also known as "control micro-adjustment;" Unsworth et al., 2012), which can be inferred from the Stroop task.

Functions of Affect in Sequential Conflict Adjustment (EF3)

Sequential conflict adjustment is observed during tasks involving many trials, each of which requires responding to incongruent or congruent stimuli. Usually, the Stroop task

[2] This resembles automatic correction (Glaser & Banaji, 1999), which consists in prolonging response time to affectively congruent and extremely strong emotogenic stimuli. In our studies this phenomenon was observed only when negative stimuli were introduced as priming (Kolańczyk & Pawłowska, 2002; Kolańczyk 2001b). We attributed this effect to early attention engagement by an extremely negative stimulus (with prime exposition of 75 and 100 ms).

[3] In the early studies of Bruner & Postman (1949) the recognition of incongruent playing cards (e.g., black hearts) proceeded by, *inter alia*, full assimilation to the pattern ("this is a heart") or by partial assimilation (compromise responses such as "brown heart" or "red heart with a black border").

or the flanker task is used for this purpose. The indicator of response adjustment is the improvement of a score in trial *n*, following a conflictual trial *n* – 1. Therefore, a study on the role of affect in sequential conflict adjustment should involve several consecutive trials and verify the impact of the previous trial on performance in the current one. Conclusions regarding adaptation to conflict cannot be drawn basing solely on affective response (e.g., negative one) to an incongruent stimulus, even though such attempts have been made (Fritz & Dreisbach, 2015).

Botvinick's idea (2007) that negative affect plays a decisive role in adaptation to conflict has influenced recent experimental studies, but it was quickly demonstrated to be insufficient (Silvetti, Seurinck & Verguts, 2011; Schouppe, Braem, De Houwer, Silvetti, Verguts, Ridderinkhof & Notebaert, 2015; Fritz, Fisher & Dreisbach, 2015). The hypothesis of passive shaping of cognition by conflict and negative affect (e.g., more profound, analytical processing increasing the likelihood of making top-down decisions; Zadra & Clore, 2011; Botvinick, 2007) was soon replaced by motivational explanations. In the studies by Schouppe et al. (2015), participants first performed the flanker task (experiment 1) or the Stroop task (experiment 2) to completion. Subsequently, they evaluated stimuli from the previous task (both congruent and incongruent ones) in the affective priming paradigm. The authors confirmed that incongruent primes, relative to congruent primes, accelerate responses to positive words (activate positive affect), "because the conflict elicited by the incongruent primes had to be resolved" (Schouppe et al., 2015, p. 252). The rather complex protocol used in the study renders the multitude of assumptions used in the calculations debatable. Similarly debatable, and even more so, is the validity of studying adaptation to conflict based on a sequence of evaluation responses to colorful words after performing and completing the previous task (but not before the performance of the Stroop task). More importantly, here too it was shown that positive affect may serve a role in adaptation to conflict (here: through reinforcement resulting from a correct response). The authors distance themselves from Botvinick's ideas (2007) about the negative affect/emotion being the prime mover, instead agreeing with Silvetti, Seurinck & Verguts (2011) that after incongruent trials, which activate negative affect, negative expectation (implicit or explicit) may occur with regard to subsequent trials. In such a case, the correct response is a source of stronger inner reward (than after easy, congruent trials), which in turn facilitates subsequent responses of this type. "The rewarding value of resolving an incongruent stimulus may motivate a person to enhance the task focus that drove him/her to that response" (Schouppe et al., 2015, p. 259). This explanation refers to the motivation of the subject and supports the thesis that automatic-motivational reasons for control microadjustment may replace the *homunculus* of the central executive.

The most recent studies by Fritz, Fischer and Dreisbach (2015), also inspired by Botvinick's ideas (2007), lead to similar interpretations. The only difference is that in these studies sequential conflict adjustment was gauged DURING task performance rather than after its completion. The actual Stroop task and flanker task were used, but the measurement of affective reactions was replaced with affect manipulation via processing fluency. The flanker task consisted in detecting the color of a central square surrounded on both sides by squares whose color was congruent or incongruent with that of the central square. In the subsequent experiment the Stroop task was used. In fluent conditions (positive affect), the figure/word contrast in relation to the background (color saturation) was 100%, and only 50% in disfluent conditions. In both experiments conflict adaptation effects were only present in fluent, but absent in disfluent trials. The authors presume it was the aversive signal expressing the magnitude of conflict that indicated an inconsistency, while positive affect, dependent on processing fluency, activated an adjusting response to priming conditions. It was also noted that adding negativity to incompatible stimuli via disfluency does not increase the effect on adaptation to conflict, and could even decrease this effect. Therefore, the negative affect alone does NOT determine microadjustment. "Yet it seems that aversive stimulus information from different sources (here: from perceptual fluency vs. response conflict) does not add up to increase sequential conflict adaptation. Thus, it is conceivable that aversiveness might need to be tied to conflict processing and not to stimulus processing in general" (Fritz, Fisher & Dreisbach, 2015, p. 9). This conclusion is fully in line with the motivational approach to EFs 2 & 3 presented in this paper. The authors explicitly refer to the microadjustment mechanism as "adaptation-by-motivation account," which means that conflict adaptation is triggered by the rewarding experience of conflict resolution (according to the observation that solving a difficult task is more rewarding than solving an easy task; Shalley and Oldham, 1985).

The affective mechanism of adaptation to conflict, understood in this way, employs minimal attention resources, because it does not require the intervention of metacognition and self-control. This explains the results of studies by Unsworth, Schrock and Engle (2012), which indicate an "automatic" nature of control microadjustment. No differences in response time after an error, or in the improvement of performance after incompatible stimuli were observed in people differing in WMC. For instance, no differences were observed in responses to words following incongruent trials in the Stroop task. The authors argued that WM resources did not need to be engaged to cope with response adjustment to conflict of this type. This conclusion could be formulated more cautiously, i.e., that WM resources were needed to a much lesser degree than when maintaining goals, and therefore did not influence individual differences in responses.

The assumed difference between lower-order control and self-control leads to another conjecture. It is not EFs *per se* that are resource-consuming, but rather metacognitive and self-control processes that occupy the focus of attention due to EFs. The intentional suppression of interfering emotions and thoughts is certainly resource-

consuming (Baumeister et al., 1998; Wegner, Erber, 1992), and so is, albeit to a lesser degree, inhibition in the Stroop task. The more attention is used up by inhibition in the Stroop task, the more it involves metacontrol processes (becoming a less reactive response), and the worse are the predictions for the course of metaregulation. The automatic activation of negative affect by undesired response (in the presence of cognitive conflict) may lead to its resolution (i.e., response inhibition) at the lower-order level of control. This leaves more room for other, demanding operations of metacognition and self-control.

Regulatory Mindset as Indicator of Affective Control over Attention Resources – a Supplement to Motivational Characteristic of Central Executive

So far, I have tried to demonstrate that the central executive, a *homunculus* in human activity, is, to a considerable degree, a reflection of a self-organizing structure of goals and means. These are activated both in a top-down and a bottom-up manner (by cues from the environment), and, owing to activation and evaluation, are capable of engaging attention, potentially leading to metacognition and the activation of self-control. This entire process of contents percolating towards the focus of attention is carried out through basic motivational operations in the form of positive affects. Working memory EFs act like a sluice gate to the focus of attention, since owing to positive affects the contents that are relevant to the activity being carried out are maintained in the focus of attention, at the cost of other, irrelevant and distractive contents marked with negative affect. Moreover, the role of control functions also consists in "calibrating the sluice gate" to the conditions of processing (microadjustment). Therefore, they act as comparators of the activation and value of LTM contents shifted into the focus of attention, enabling the organization of activities and delegating to self-control only the crucial decisions, which cannot be made in the course of affective estimation of responses.

EFs are activated not only by the network of goals and by available means. The repertoire of EFs also depends on the style of goal implementation, determined by regulatory standards. It is known that the standards of achievements, power or affiliation influence the manner in which tasks, such as helping others, are undertaken (Schultheiss & Brunstein, 1999). However, the most basic regulatory standards and mindsets result from priorities given to action or reflection. Focus on action vs. situational diagnosis can be observed in its purest form at the level of reactive behaviors. Two kinds of neuronal paths have been identified – one ensuring quick responses, particularly significant under threat, and another one, which ensures explicit situational diagnosis (Milner & Goodale, 1995; LeDoux, 1996). Purposive actions (involving WM) are too complex for such clear-cut divisions to be drawn. Cognition and evaluations partake in every purposive action. However, the focus on action vs. situational diagnosis significantly changes information processing, not excluding cognitive control. According to the philosopher Hanah Arendt (1981) inquisitive thinking requires "withdrawing" from action, since action "demands" provisional judgments built on clichés, superstitions, etc. Action involves "fast thinking" (Kahneman, 2011), which is more often intuitive and draws from the statistics of experience.

Action/Promotion and Reflection/Prevention Mindsets

Action vs. reflection mindset (also presented in terms of disposition) constitutes the core of several theories, which can be termed metamotivational. They encompass the concept of promotion vs. prevention regulatory focus (Higgins, 1997; 2012), action vs. state orientation (Kuhl, 1985), the classical Maslow's theory of focus on development vs. safety and defense (1956), and the more processual concept of locomotion vs. assessment mode (Kruglanski, Thompson, Higgins, Atash, Pierro, Shah & Spiegel, 2000).[4]

According to Gray action focus results from the activation of BAS (the Behavioral Approach System; cf. Corr, 2004). The focus on reflective evaluation of events is aimed at avoiding failure; however, it is different from simple avoidance, which involves moving away from the goal. According to the most recent approach of Corr, the FFFS (Fight-Flight-Freeze System) is responsible for avoidance, whereas, reflective goal pursuit is best explained by BIS (Behavioral Inhibition System), activated by motivational conflict, which leads to uncertainty and anxiety. Thus a cautious approach to goal attainment is effectuated, with simultaneous hedging against failure. In the prevention focus, conflict is inherent in goal attainment. Based on the theory of regulatory focus (developed over many years in various laboratories) as well as owing to the elaborated method of studying individual differences – the Promotion and Prevention Self-Regulation Scale, PPSS (Kolańczyk, Bąk & Roczniewska, 2013), we carried out studies of two control modes (with an action vs. diagnosis dominant). Even though the self-report method does not give insight into EFs, we assumed that it constitutes a sufficiently accurate metacognitive indicator of differences in promotion vs. prevention self-regulation. We made conclusions regarding its manifestations on the basis of a number of studies (e.g., Förster & Higgins, 1997, 2005; Friedman & Förster, 2001; Van-Dijk & Kluger, 2004; Semin, Higgins, de Montes, Estourget, & Valencia, 2005).

[4] The method of studying *locomotion vs. assessment mode* raises doubts, e.g., *locomotion mode* encompasses pathological work engagement ("*I am a workaholic*"), while *assessment mode* pertains to all sorts of evaluation mindsets, including those that are obsessive (in this respect it resembles Kuhl's approach to state orientation ("*I spend a great deal of time taking inventory of my positive and negative characteristics*;" Kruglanski et al., 2000, p. 798). Similarly, we are of the opinion that disregarding regulatory standards determining the mode of self-regulation leads to throwing the baby out with the bathwater.

Promotion self-regulation can be defined as action-intuitive and optimistic. A person in this mindset makes use of available and sufficiently useful data, processing it intuitively. In contrast, prevention self-regulation is characterized by analyzing potential or current obstacles on the path to the goal with the aim of verifying whether the assumed way of thinking or direction of action is correct (Kolańczyk, Bąk & Roczniewska, 2013; Kolańczyk, 2011). The course of promotion self-regulation is dominated by positive mood, whereas prevention self-regulation – by negative mood (Amodio, Shah, Sigelman, Brazy, Harmon-Jones, 2004; Cunningham, Raye & Johnson, 2005; Summerville & Roese, 2008; Kolańczyk, Bąk & Roczniewska, 2013). Moreover, a positive affective background facilitates global and intuitive information processing, while its negative counterpart favors analytical and profound processing (Schwarz & Bless, 1991; Bless, Schwarz & Wieland, 1996; Jefferies, Smilek, Eich & Enns, 2008; Kappes, Oettinger, Maeyer & Maglio, 2011; Fredrickson & Branigan, 2005; Kolańczyk, 2011; Zadra, Clore, 2011; Huntsinger, Isbell & Clore, 2014). It comes as no surprise then that a "wandering mind is an unhappy mind," as expressed by Killingsworth and Gilbert (2010). From the hedonistic perspective they adopted it follows that "the ability to think about what is not happening is a cognitive achievement that comes at an emotional cost" (p. 932). These observations are of utmost significance to our predictions on EFs in relation to regulatory focus.

Role of Affects in Maintaining Goals Depending on Promotion vs. Prevention Focus (EF1 & EF2)

The promotion/action mindset determines the active implementation of goals, and its *raison d'être* is the belief that the goal is realistic and attainable (Higgins, 1997; Shah & Higgins, 1997). The introduction of a goal into the focus of attention and subsequently maintaining it through positive affect (the activity of the reverberatory loop) constitutes the basis for action. Therefore, in promotion focus positive affect should play a key role, as it is responsible for maintaining goals and means (EF1). This is in line with Ferguson and Bargh's postulate (2004) that "liking is for doing". In the prevention focus, apart from the activation of goal and plan (which in this case gains additional significance), controlled incompatible contents (distractors and means with unclear value) need to be maintained in the focus of attention; these contents must be checked and thoroughly verified for the goal to be attained, once the plan either passes verification or is rejected. If it is positive affect that ensures motivational maintaining and updating of contents in the focus of attention, then in the prevention focus the contents that jeopardize goal attainment should be evaluated positively as well. This hypothesis is counter-intuitive, since positive affect, similarly to emotion, usually brings one closer to a positive object rather than to an object that poses a threat of losing (the chance to complete the goal). However, exceptions to this rule arise when a person controls a negative object through getting closer to it. This is the case with anger, which many authors perceive as a positive emotion (Jarymowicz & Imbir, 2010; Harmon-Jones & Sigelman, 2001). Anger allows to get closer to an object for the purpose of controlling it, usually by means of aggression. Neuropsychological studies have shown that positive activation (i.e. neuronal circuits that are responsible for positive affects) takes part in anger response (Harmon-Jones, Harmon-Jones, Abramson, & Peterson, 2009)[5]. Therefore, we can presume that in the prevention focus (by means of positive affect) potential obstacles to goal completion will be directed into the focus of attention for monitoring, so as to further verify their influence on goal attainment.

In contrast, when distractors or contents that have been unambiguously evaluated as irrelevant or overloading operational resources enter attention, they are marked with negative affect, supporting inhibition and their subsequent exclusion from the scope of attention (Brendl, Markman, Messner, 2003; Raymond, Fenske, Westoby, 2005). In the prevention focus task solving strategies are more analytical and effortful (than in the promotion focus), which increases the likelihood of operational overload, along with negative affects, promoting disengagement ("evicting" unnecessary contents out of scope of attention).

The above predictions have been verified through several research plans, described in independent papers and a book *Samo się nie myśli* (*It Does Not Think Itself*; Kolańczyk, 2014; Roczniewska, 2014). The design of each study was similar. Participants were asked to complete a variety of tasks, and the implicit evaluations of objects that aided solving, distracted from it, or were irrelevant, were studied. The affects assigned to objects appearing in the task were inferred from the implicit evaluations, measured twice: in the pre-task condition and once the participants were acquainted with the task (but before it was solved, to retain the motivational role of affect). The tasks consisted in: (1) a detection computer game where vegetarian dishes were to be spotted, and non-vegetarian dishes were to be avoided (Roczniewska & Kolańczyk, 2012); (2) a selection of cards to be uncovered when verifying the rule in the Wason Selection Task (content version of WST; Kolańczyk & Roczniewska, 2015); (3) a decision-based computer game, in which participants decide whether to approach positively-inclined and negatively-inclined people for directions to a hidden treasure (Kolańczyk & Roczniewska, 2015); (4) arranging domino pieces into a given shape, with implicit evaluation of traits facilitating performance of this task (agentic traits) and those of no significance to its completion (communal or neutral traits; Roczniewska & Kolańczyk, 2014).

Two experimental paradigms were employed in the study of implicit evaluations: a) affective priming (Fazio, 2001); and b) affect misattribution (introduced by Murphy

[5] A study employing fMRI demonstrated the similarity of the patterns (*neural signatures*) corresponding to anger and joy (whereas, no such similarities between basic negative emotions have been found; Kassam, Markey, Cherkassky, Loewenstein & Just, 2013).

& Zajonc, 1993). The first approach (used in tasks 1–3) was also employed in the previously described studies on the attitude towards Stroop's incongruent colorful words (Dreisbach & Fischer, 2012; Schouppe et al., 2015). The affective priming paradigm makes use of affective consistency, i.e., the increased accessibility of target stimuli marked with the same affect as the studied priming stimulus (e.g., categorization of the word "beautiful" is quicker after the word "pancakes", if the participant likes them). The second approach (used in task 4) consists in attributing the affect activated by the priming stimulus to the neutral target stimulus. If the target hexagram is assessed positively, we infer the presence of positive affect activated by priming, e.g., the word "pancakes." In each experiment regulatory focus was a factor, and in most cases it was diagnosed using the PPS scale (PPSS; Kolańczyk et al., 2013) after the study was completed. Only in the first experiment, the promotion vs. prevention mindset was being manipulated.[6]

To a large degree, the results of experiments confirmed our predictions. Each significant effect related to implicit evaluations was observed only in the scenario where participants were acquainted with the task (after goal activation, but before its completion). The experiment in which mindset was manipulated allowed to positively verify the entirety of the model. Objects linked with the goal (vegetarian dishes) were marked with positive affect in both regulatory mindsets. However, only in the prevention mindset positive affect was attributed to objects subjected to falsification (meat dishes). Whereas, indifferent objects (cutlery, furniture) were evaluated negatively, also in the prevention mindset, where operational overload may ensue more rapidly. The remaining results supported our predictions partially, in some cases this was by construction. In order to solve the Wason Selection Task correctly, it is necessary to falsify the given rule by uncovering the card whose content is absent from the description given in the instructions. (If the rule dictated that only adults can be served alcohol, it was required to check whether minors do not drink.) In line with our predictions, in participants in the prevention mindset the valuation of cards that falsified the rule was observed immediately after they got acquainted with the task. In the thought process this corresponds to the tendency of cautious control. Participants in the promotion mindset, on the other hand, attributed positive affect to cards that were available, e.g., whose contents were described by the rules, which usually leads to confirmation bias. Despite habitual inclinations of attention at the beginning of inference, related to positive marking of available contents, ultimately the WST was correctly solved by the majority of participants, owing to the relatively low difficulty in terms of contents.

In experiments employing the PPS Scale significant results were obtained mainly for the promotion mindset, probably due to strong motivation that correlates with this mindset (diagnosed, among others, using the same PPSS), and the action-oriented nature of the tasks. Strong motivation is essential for the controlling influence of affect to manifest (Ferguson & Bargh, 2004). This is also an indication of the relative importance of positive affect when implementing goals (maintaining in the scope of attention), rather than when preventatively postponing them (in WM, outside the attention focus) until the situation can be assessed. In the decision game simulating the actions of a treasure hunter, only the participants in the promotion mindset responded with positive affect to the names of people who had helped them by giving correct directions leading to the goal. In the final construction task (domino), goal activation led to the valuation of traits useful for the task at hand (agentic traits, e.g., "agile"), as well as to the attribution of negative affect to features irrelevant to the task (communal traits, e.g., "honest"), but also only in the case of participants in the promotion mindset. The activation of one's unpurposed traits may redirect attention to behaviors irrelevant for a precision task, activating inhibition response, also in highly motivated, promotion-oriented persons.

To summarize, the hypothesis pertaining to EF1 – that positive affect maintains the means of goal attainment in the focus of attention, with the means differing between the promotion and prevention mindsets – gained empirical confirmation. In the prevention mindset, positive affect additionally drives towards the focus of attention those means that must be verified to prevent failure. It was also shown that negative affect leads to the inhibition (EF2) and disengagement of attention from distracting or irrelevant objects (information noise). It turns out that the devaluation of objects depends on the task context, the power of motivation and the current mindset (it was observed once in the prevention mindset – during the performance of a detection task, and for the second time in the promotion mindset – during the performance of a construction task). One can argue that decision and construction tasks are better suited to focus on action, which might have amplified the observed effects (Spiegel, Grant-Pillow, Higgins, 2004).

Conclusions

The most recent research achievements in two fields enjoying relatively independent development: motivational psychology and working memory theories concentrate on a common core, i.e. purposive activity. Drawing on these achievements, which appear sufficient for initiating discussion, I proposed fusing studies on certain executive functions (i.e., on the procedural aspect of WM; Oberauer, 2010) with studies on implicit purposive motivation. The theory of motivational processes serves as a foundation from which research paradigms were borrowed. Recently, it has been demonstrated that aspirations are to a large extent derived from a self-organizing structure of goals and means, activated both in a top-down and a bottom-up manner (by cues from the environment; Kruglanski

[6] We employed the measure of promotion vs. prevention (PPSS) in order to mitigate concerns regarding the asymmetry in fitting the task to regulatory focus (regulatory fit; Spiegel, Grant-Pillow, Higgins, 2004), as well as due to the observed difficulties involved in efficiently manipulating promotion.

et al., 2002; 2014). The formation of cognitive mindsets and evaluation criteria, which also serve cognitive control, depends on the situational activation of the motivation. Affects in purposive activity are the results of evaluating objects that are conducive to or interfere with achieving aims (with a temporary change of implicit attitudes towards them allowing the right direction of activity to be maintained).

The principal difference between the traditional formulation of executive functions (EFs) and the approach proposed in this work is the assumption that control processes can be motivated implicitly.[7] These are the lower-order control, available to metacognition to a similar degree as intuitive processes (in the form of sensations and gut feelings). The above applies also to cognitive inhibition, which can be triggered by a feature of the stimulus (e.g., word color), most probably through the same principle as the involuntary inhibition of temptation in goal pursuit (Fishbach & Shah, 2006). Due to the predicted similarity of EFs during task solving, I have given similar status to the Stroop task, the WST and the detection tasks.

Positive affects (activated for the duration of goal pursuit) are the operations that promote the maintenance of goals and means in the scope of attention (EF1). This is confirmed by studies on biological goals, detection tasks, the WST or the construction task. In the prevention mindset, the means carrying a risk of failure are also marked with positive affect (these can be purged from the focus of attention once they are verified). By contrast, positive affect activated in the course of cognitive control (in the Stroop task and the flanker task) was observed at the stage of conflict adaptation. This is due to the fact that implementation of goals and means, as well as the maintenance of targeted action, take place owing to positive affect. Linking positive affect with a goal by using incentives during the performance of tasks testing cognitive control (in the Continuous Performance Test; AXCPT) led to a significantly improved performance. Using neuroimaging (fMRI) it was demonstrated that a "sustained increase in a primarily right-lateralized network that included parietal and prefrontal cortex" (Locke & Braver, 2008, p. 99) is responsible for the improvement of cognitive control resulting from reward.

Implicit response inhibition is, in turn, brought about by negative affects, activated automatically as soon as contents that are not functional in relation to the goal engage attention (EF2). These processes take place during the preconscious engagement of attention, and proceed reactively (similarly to goal activation by a stimulus). Only when attention is engaged more intensely or for longer, due to difficulties in selecting a reaction, do effects like the suppression of the incongruent word through various strategies (e.g., squinting) occur. This is inferred from studies on negative marking of distractors and stimuli irrelevant to the goal. In our studies, this effect was observed in the detection task as well as in the construction task. So far, we do not have a clear confirmation of the role of negative affect in inhibiting response to the distractive feature of incompatible stimulus in the Stroop task, as affective responses to words such as "GREEN in red lettering" were assessed without first acquainting study participants with the task (responding to the color or meaning of a word). Negative affect was triggered by the incongruence of a stimulus rather than by the distractive feature which would directly activate inhibition response (e.g., Dreisbach & Fischer, 2012). Negative affect was deemed to influence, for instance, the mode of information processing, i.e., to act indirectly. Therefore, this area would benefit from further verification studies.

Task switching, an EF which consists in replacing the current action program with a new one, thus leading to conflict, was not considered in this paper, chiefly due to the lack of applicable studies on the topic. Having assumed the motivational approach proposed in this article, one could formulate a number of predictions. If a person stores task in WM while solving another task (as e.g., in the retrieval-induced forgetting (RIF) paradigm; Kolańczyk, Reszko, Mordasiewicz, 2013; Kolańczyk & Reszko, 2014), the temporarily irrelevant task may be automatically marked negatively while continuing to be maintained in WM by positive affect (reverberatory loop). Depending on the level of attention stimulation by conflictual affects and the incongruence of response itself, different scenarios of implicit control (or intentional self-control) become possible. When contents are activated so strongly as to reach the metacognitive level, purposive suppression is expected to replace cognitive inhibition. Suppression, however, is effective only temporarily, i.e., suppressed contents remain in WM and are secondarily hyper-accessible to attention (Wegner & Erber, 1992). New research lines devoted to the explanation of task switching (EF4) open. Primarily, one would need to consider affective mechanisms for the implicit initiation of switching and for adapting to changing action programs (analogous to adaptation to conflict; Śmigaszewicz, Szymura & Słabosz, 2004).

References

Aarts, H., Custers, R. & Holland, R. W. (2007). The nonconscious cessation of goal pursuit: When goals and negative affect are coactivated. *Journal of Personality and Social Psychology*, *92 (2)*, 165–178.

Amodio, D. M., Shah, J. Y., Sigelman, J., Brazy, P. C., & Harmon-Jones, E. (2004). Implicit regulatory focus associated with asymmetrical frontal cortical activity. *Journal of Experimental Social Psychology, 40*, 225–232.

Arendt, H. (1978). *The Life of the Mind: 1 Thinking*. M. McCarthy (Ed). Harcourt Brace Jovanovich, Inc.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. A. Bower (Ed.), *The psychology of learning and motivation* (*Vol. 8*, pp. 47–89). New York: Academic Press.

Baddeley, A. D., & Logie, R. H. (1999). Working memory: The multiple-component model. In A. Miyake & P. Shah (Eds.), *Models of working memory* (pp. 28–61). New York: Cambridge University Press.

[7] The studies on "implicit working memory" were proposed by Hassin (2005; Hassin et al., 2009) in a discussion on the leading role of consciousness in WM. Although he was referring to the discovered motivation automatisms, he conducted studies on implicit insights (i.e., the mind extracts patterns, rules that relate two or more objects or events in a stimulus space) that occur in WM.

Bargh, J. A., Gollwitzer, P. M., Lee-Chai, A., Barndollar, K., & Troetschel, R. (2001). The automated will: Nonconscious activation and pursuit of behavioral goals. *Journal of Personality and Social Psychology*, *81*, 1014–1027.

Bélanger, J. J., Lafrenière, M. A. K., Vallerand, R. J., & Kruglanski, A. W. (2013). When passion makes the heart grow colder: The role of passion in alternative goal-suppression. *Journal of Personality and Social Psychology*, *104 (1)*, 126–147.

Berridge, K. C., & Aldridge, J. W. (2008). Decision utility, the brain, and pursuit of hedonic goals. *Social Cognition*, *26 (5)*, 621–646.

Bless, H., Schwarz, N., & Wieland, R. (1996). Mood and the impact of category membership and individuating information. *European Journal of Social Psychology*, *26*, 935–959.

Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal or Personality and Social Psychology, 74 (5)*, 252–1265.

Botvinick, M. M. (2007). Conflict monitoring and decision making: Reconciling two perspectives on anterior cingulate function. *Cognitive, Affective, & Behavioral Neuroscience, 7*, 356–366.

Braver, T. S., Bargh, D. M., & Cohen, J. D. (2002). The role of prefrontal cortex in normal and disordered cognitive control: A cognitive neuroscience perspective. In D. T. Stuss, R. T. Knight (Eds.), *Principles of frontal lobe function* (pp. 428–448). Oxford, England: Oxford University Press.

Brewin, C. R., & Beaton, A. (2002). Thought suppression, intelligence, and working memory capacity. *Behaviour Research and Therapy, 40 (8)*, 923–930.

Brendl, C. M., Markman, A. B., & Messner, C. (2003). The devaluation effect: Activating a need devalues unrelated objects. *Journal of Consumer Research*, *29*, 463–473.

Broadway, J. M., Redick, T. S., Engle, R. W. (2010). Working Memory Capacity: Self-control is (in) the goal. In: R. Hassin, K. Ochsner, and Y. Trope, Self control in society, mind, and brain. Print ISBN-13: 9780195391381.

Brosch, T., Scherer, K. R., Grandjean, D., & Sander, D. (2013). The impact of emotion on perception, attention, memory, and decision-making, *Swiss Medical Weekly.* w13786.

Bruner, J. S., & Postman, L. (1949). On the perception of incongruity: a paradigm. *Journal of Personality*, *18*, 206-223.

Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin, 25*, 215–224.

Chiew, K. S., & Braver, T. S. (2011). Positive affect versus reward: emotional and motivational influences on cognitive control. *Frontiers in Psychology*, *2*, 279.

Cleermans, A., & Jiménez, L. (2002). Implicit learning and consciousness: A graded, dynamic perspective. In R. M. French, A. Cleermans (Ed.), *Implicit learning and consciousness* (p. 1–40). Hove, UK: Psychology Press.

Cohen, J. D., Aston-Jones, G., & Gilzenrat, M. S. (2004). A systems-level perspective on attention and cognitive control: Guided activation, adaptive gating, conflict monitoring, and exploitation vs. exploration. In M. I. Posner (Ed.), *Cognitive neuroscience of attention* (pp. 71–90). New York, NY: Guilford Press.

Cowan, N. (1999). An embedded – processes model of working memory. In A. Miyake, P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 62–101). Cambridge: Cambridge University Press

Corr, P. J. (2004). Reinforcement sensitivity theory and personality. *Neuroscience and Biobehavioral Reviews*, *28*, 317–332.

Critchley H. D. (2005). Neural mechanisms of autonomic, affective and cognitive integration. *Journal of Comparative Neurology, 493*, 154–166.

Cunningham, W. A., Raye, C. L., & Johnson, M. K. (2005). Neural correlates of evaluation associated with promotion and prevention regulatory focus. *Cognitive, Affective, & Behavioral Neuroscience, 5*, 202–211.

Custers, R., & Aarts, H. (2005). Positive affect as implicit motivator: On the nonconscious operation of behavioral goals. *Journal of Personality and Social Psychology, 89 (2)*, 129–142.

Derryberry, D., & Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology*, *111 (2)*, 225–236.

Dreisbach, G., & Fischer, R. (2012). Conflicts as aversive signals. *Brain and Cognition. 8 (2)*, 94–8.

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science*, *11*, 19–23.

Engle, R. W., & Kane, M. J. (2004). Executive attention, working memory capacity, and a two-factor theory of cognitive control. In B. Ross (Ed.). *The psychology of learning and motivation, 44* (pp. 145–199). NY: Elsevier.

Fazio, R. H. (2001). On the automatic activation of associated evaluations: An overview. *Cognition and Emotion*, *14*, 1–27.

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, *50*, 229–238.

Feldman Barrett, L., Tugade, M. M., Engle, R. W. (2004). Individual differences in working memory capacity and dual-process theories of the mind. *Psychological Bulletin*, *130 (4)*, 553–573.

Ferguson, M. J. (2008). On becoming ready to pursue a goal you don't know you have: Effects of nonconscious goals on evaluative readiness. *Journal of Personality and Social Psychology, 95 (6)*, 1268–1294.

Ferguson, M. J., & Bargh, J. A. (2004). Liking is for doing: the effects of goal pursuit on automatic evaluation. *Journal of Personality and Social Psychology*, *87 (5)*, 557–572.

Festinger, L. (1957). *A Theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Fishbach, A., & Shah, J. Y. (2006). Self control in action: Implicit dispositions toward goals and away from temptations. *Journal of Personality and Social Psychology, 90 (5)*, 820–832.

Fishbach, A., Friedman, R. S., & Kruglanski, A. W. (2003). Leading us not into temptation: Momentary allurements elicit overriding goal activation. *Journal of Personality and Social Psychology*, *84*, 296–309.

Fishbach, A., Shah, J. Y., & Kruglanski, A. W. (2004). Emotional transfer in goal systems. *Journal of Experimental Social Psychology, 40*, 723–738.

Förster, J., & Higgins, E. T. (1997). *Approach and avoidance gradients from strategies in goal attainment. Regulatory focus as moderator.* Unpublished manuscript, Columbia University.

Förster, J., & Higgins, E. T. (2005). How global versus local perception fits regulatory focus. *Psychological Science*, *16*, 631–636.

Förster, J., Liberman, N., & Higgins, E. T. (2005) Accessibility from active and fulfilled goals. *Journal of Experimental Social Psychology*, *41 (3)*, 220–239.

Franken, R.E. (2005). *Psychologia motywacji*. Gdańsk: GWP.

Fredrickson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and though action repertoires, *Cognition and emotion*, *19 (3)*, 313–332.

Friedman, R. S., & Förster, J. (2001). The effects of promotion and prevention cues on creativity. *Journal of Personality and Social Psychology*, *81*, 1001–1013.

Fritz, J., & Dreisbach, G. (2015). The time course of the aversive conflict-signal. *Experimental Psychology, 62 (1)*, 30–39.

Fritz, J., & Dreisbach, G. (2013). Conflicts as aversive signals: Conflict priming increases negative judgments for neutral stimuli. *Cognitive, Affective & Behavioral Neuroscience, 13*, 311–317.

Fritz, J., Fisher, R. & Dreisbach, G. (2015). The influence of negative stimulus features on conflict adaption: evidence from fluency of processing. *Frontiers Psychology*, 6: 185.

Glasler, J., & Banaji, M. R. (1999). When fair is foul and foul is fair: Reverse priming in automatic evaluation. *Journal of Personality and Social Psychology, 4*, 669–687.

Gasper, K. & Hackenbracht, J. (2015). Too Busy To Feel Neutral: Reducing Cognitive Resources Attenuates Neutral Affective States. *Motivation and Emotion, 39 (3)*, 458–466.

Goschke, T., & Kuhl, J. (1993). Representation of intentions: Persisting activation in memory. *Journal of Experimental Psychology: Learning, Memory,and Cognition*, *19 (5)*, 1211–1226.

Gotoh, F., Kikuchi, T. & Olofsson, U. (2010). A facilitative effect of negative affective valence on working memory. *Scandinavian Journal of Psychology, 51*, 185–191.

Harmon-Jones, E., Harmon-Jones, C., Abramson, L., & Peterson, C. K. (2009). PANAS Positive activation is associated with anger. *Emotion, 9*, 183–196.

Harmon-Jones, E., & Sigelman, J. (2001). State anger and frontal brain activity: Evidence that insult-related relative left prefrontal activation is associated with experienced anger and aggression. *Journal of Personality and Social Psychology, 80*, 797–803.

Hassin, R. R. (2005). Non-conscious control and implicit working memory. In: R.R. Hassin, J.S. Uleman, J.A. Bargh, (Eds). *The new unconscious* (pp. 196–225) New York: Oxford University Press.

Hassin, R. R., Bargh, J. A., Engell, A. D., & McCulloch, K. C. (2009). Implicit working memory. *Conscious Cognition, 18, 3*, 665–678.

Hermans, D., De Houwer, J., & Eelen, P. (2001). A time course analysis of the affective priming effect. *Cognition and Emotion*, *15*, 143–165.

Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist*, *52 (12)*, 1280–1300.

Higgins, E. T. (2012). *Beyond pleasure and pain: How motivation works*. New York: Oxford University Press.

Higgins, E. T., Friedman, R. S., Harlow, R. E., Idson, L. C., Ayduk, O. N., & Taylor, A. (2001). Achievement orientations from subjective histories of success: Promotion pride versus prevention pride. *European Journal of Social Psychology, 31*, 3–23.

Huntsinger, J. R., Isbell, L., & Clore, G. L. (2014). The affective control of thought: Malleable, not fixed. *Psychological Review*, *121 (4)*, 600–618.

Jarymowicz, M., & Imbir, K. (2010). Próba taksonomii ludzkich emocji. [An attempt to taxonomy of human's emotions]. *Przegląd Psychologiczny, 53 (4)*, 439–461.

Jasinska, A.J. (2013). Automatic inhibition and habitual control: alternative views in neuroscience research on response inhibition and inhibitory control. *Frontiers in Behavioral Neuroscience,* 7: 25.

Jefferies, L. N., Smilek, D., Eich, E., & Enns, J. T. (2008). Emotional valence and arousal interact in attentional control. *Psychological Science*, *19 (3)*, 290–295.

Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.

Kane, M. J., & Engle, R. W. (2003). Working memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop interference. *Journal of Experimental Psychology: General, 132*, 47–70.

Kappes, H. B., Oettingen, G., Mayer, D., & Maglio, S. (2011). Sad mood promotes self-initiated mental contrasting of future and reality. *Emotion, 11*, 1206-1222.

Kassam, K. S., Markey, A. R., Cherkassky, V. L., Loewenstein, G., & Just, M. A. (2013). Identifying Emotions on the Basis of Neural Activation. *PLoS ONE, 8 (6): e66032*.

Killingsworth, M. A. & Gilbert, D. T. (2010). A wandering mind is an unhappy mind, *Science, 330, 6006*, p. 932.

Kolańczyk, A. (2001). The role of affect in preconscious and conscious processing. *Polish Psychological Bulletin, 32 (1)*, 27–37.

Kolańczyk, A. (2008). Wpływ samokontroli na wartościowanie treści związanych z zadaniem. [The effect of self-control on evaluation of meanings related to a task]. *Czasopismo Psychologiczne, 14 (2)*, 201–214.

Kolańczyk, A. (2011). Uwaga ekstensywna. Model ekstensywności vs. intensywności uwagi. [Extensive attention. The extensive vs. intensive attention model] *Studia Psychologiczne*, *49*, *(3)*, 7–27.

Kolańczyk, A. (2014). Afektywna samoregulacja intencjonalnego poznania. [Affective selfregulation of intentional cognition]. In A. Kolańczyk (ed.) *Samo się nie myśli. Afekt w procesach poznawczych.* [It does not think itself. Affect in cognitive processes] (pp. 13–69). Sopot: Smak Słowa.

Kolańczyk, A., & Pawłowska-Fusiara, M. (2002). Automatic correction or controlled processing of affective priming, *Polish Psychological Bulletin, 33, (2)*, 35–44.

Kolańczyk, A., Reszko, M., & Mordasiewicz, P. (2013). Attentional control and retrieval induced forgetting. Selfregulation perspective. *Polish Psychological Bulletin. 44 (1)*, 56–69.

Kolańczyk, A., Bąk, W., & Roczniewska, M. (2013). Skala Samoregulacji Promocyjnej i Prewencyjnej (SSPP). [Promotion and Prevention Self-regulation Scale (SSPP)], *Psychologia Społeczna*. *Vol. 8, 2, (25)*, 203–218.

Kolańczyk, A., & Reszko, M. (2014). Afektywna samoregulacja procesów pamięciowych. Przypadek zapominania wywołanego przypominaniem [Affective self-regulation of memory. Te case of RIF]. In A. Kolańczyk (Ed.) *Samo się nie myśli. Afekt w procesach poznawczych.* (pp. 106–136). Sopot: Smak Słowa.

Kolańczyk, A., & Roczniewska, M. (2015). The affective self-regulation of covert and overt reasoning in a promotion vs. prevention mindset. *Polish Psychological Bulletin*, *46 (2)*, 228–238.

Kruglanski, A. W., Thompson, E. P., Higgins, E. T., Atash, M. N., Pierro, A., Shah, J. Y., & Spiegel, S. (2000). To "do the right thing" or to "Just do it": Locomotion and Assessment as distinct self-regulatory imperatives. *Journal of Personality and Social Psychology, 79*, 793–815.

Kruglanski, A. W., Shah, J. Y., Fishbach, A., Friedman, R., Chun, W. Y., & Sleeth-Keppler, D. (2002). A theory of goal systems. In M. P. Zanna (Ed.), *Advances in experimental social psychology*, *34*, (pp. 331–378). New York: Academic Press.

Kruglanski, A. W., Chernikova, M., Rosenzweig, E., & Kopetz, C. (2014). On motivational readiness. *Psychological Review*, *121*, 367–388.

Kruglanski, A. W., & Webster, D. M. (1996). Motivated closing of the mind: "Seizing" and "freezing". *Psychological Review, 103*, 263–283.

Kuhl, J. (1985). Volitional mediator of cognition-behavior consistency: Self-regulatory processes and action versus state orientation. In J. Kuhl, & J. Beckman (Eds.), *Action control: From cognition to behavior*. Heidelberg, New York: Springer-Verlag.

Lau, H., & Rosenthal, D. (2011). Empirical support for higher-order theories of conscious awareness. *Cell: Trends in Cognitive Sciences, 15 (8)*, 365–373.

LeDoux, J. E. (1996). *The Emotional Brain. The Mysterious Underprintings of Emotional Life*. New York: A Tuchstone Book; Simon Schuster.

Locke, H. S., & Braver, T. S. (2008). Motivational influences on cognitive control: behavior, brain activation, and individual differences. *Cognitive, Affective, & Behavioral Neuroscience*. *8*, 99–112.

Logan, G. (2004). Working memory, task switching, and executive control in the task span procedure. *Journal of Experimental Psychology: General, 133*, 218–236.

Mackie, M. A., Van Dam, N. T., & Fan, J., (2013). Cognitive control and attentional functions. *Brain and Cognition. 82*, 301–312.

Marien, H., Aarts, H., & Custers, R. (2012). Being flexible or rigid in goal-directed behavior: when positive affect implicitly motivates the pursuit of goals or means. *Journal of Experimental Social Psychology, 48*, 277–283.

Marien, H., Custers, R., Hassin, R. R., Aarts, H., (2012). Unconscious goal activation and the hijacking of the executive function. *Journal of Personality and Social Psychology*, *103 (3)*, 399–415.

Maslow, A. H. (1956). Defense and growth. *Merrill-Palmer Quarterly, 3*, 36–47.

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*, 49–100.

Miller, G. A., Galanter, E., & Pribram, K. A. (1960). *Plans and the structure of behavior.* New York: Holt, Rhinehart, & Winston.

Milner, A. D., & Goodale, M. A. (1995). *The visual brain in action*, *(Oxford Psychology Series, No. 27)*. Oxford University Press.

Mostofsky, S. H., Simmonds, D. J. (2008). Response inhibition and response selection: two sides of the same coin. *Journal of Cognitive Neuroscience*. *20*, 751–761.

Munakata, Y., Herd, S. A., Chatham, C. H., Depue, B. E., Banich, M. T., O'Reilly, R. C. (2011). A unified framework for inhibitory control. *Trends in Cognitive Science. 15*, 453–459.

Murphy, Sh. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with suboptimal and optimal stimulus. *Journal of Personality and Social Psychology*, *64*, 723–739.

Nęcka, E. (2009). Pamięć robocza. Wprowadzenie. [Working memory. Introduction]. In J. Orzechowski, K.T. Piotrowski, R. Balas & Z. Stettner, *Pamięć robocza.* (pp. 133–148). Warszawa: Wydawnictwo SWPS "Academica".

Nęcka, E., Orzechowski, J., & Szymura, B. (2006). *Psychologia poznawcza.* [Cognitive Psychology] Warszawa: PWN.

Nęcka, E., Lech, B., Sobczyk, N., & Śmieja, M. (2012). How much do we know about our own cognitive control? Self-report and performance measures of executive functions. *European Journal of Psychological Assessment, 28 (3)*, 240–247.

Niedenthal, P. M., Winkielman, P., Mondillon, L., & Vermeulen, N. (2009). Embodiment of emotion concepts. *Journal of Personality and Social Psychology*, *96 (6)*, 1120–1136.

Norman, D. A., Shalice, T. (1986). Attention to action. Willed and automatic control of behaviour. In R. J. Davidson, G. E., Schwarz, & D. Shapiro (Eds.) *Consciousness and self-regulation: Advances in research and theory.* Vol. 4. (pp 1–17) New York: Plenum Press.

Oberauer, K. (2010). Declarative and procedural working memory: common principles, common capacity limits? *Psychologica Belgica, 50 (3&4)*, 277–308.

Oppenheimer, D. M. (2008). The secret life of fluency. *Trends in Cognitive Science, 12 (6)*, 237–241.

Pasquali, A., Timmermans, B., & Cleeremans, A. (2010). Know thyself: metacognitive networks and measures of consciousness. *Cognition, 117, (2)*, 182–190.

Piotrowski, K. T., Settner, Z., Orzechowski, J., & Balas, R. (2009). Jak działa pamięć robocza? [How does WM operate?] In J. Orzechowski, K. T. Piotrowski, R. Balas & Z. Stettner, *Pamięć robocza.* (pp. 133–148). Warszawa: Wydawnictwo SWPS "Academica".

Piotrowski, K. T., & Wierzchoń, M. (2009). Wpływ emocji na funkcjonowanie pamięci roboczej. In J. Orzechowki, K. T. Piotrowski, R. Balas & Z. Stettner (Eds.) *Pamięć robocza.* (pp. 133–148). Warszawa: Wydawnictwo SWPS "Academica".

Posner, M. I., & Fan, J. (2008). Attention as an organ system. In J. R. Pomerantz (Eds.) *Topics in Integrative Neuroscience: From Cells to Cognition* (pp. 31–61). Cambridge University Press.

Raymond, J. E., Fenske, M. J., & Westoby, N. (2005). Emotional devaluation of distracting patterns and faces: A consequence of attentional inhibition during visual search? *Journal of Experimental Psychology, 31, (6)*, 1404–1415.

Reber, R., Winkielman, P. & Schwarz, N. (1998). Effects of perceptual fluency on affective judgments. *Psychological Science, 9*, 45–48.

Roczniewska, M., & Kolańczyk, A. (2012). Cel uświęca środki, a niekiedy przeszkody? Preferencje zależne od nastawienia regulacyjnego. [Automatic evaluation as a function of regulatory focus and goal pursuit]. *Psychologia Społeczna*, *7*, 34–47.

Roczniewska, M. (2014). Afektywna samoregulacja myślenia. [Affective selfregulation of thnking] In A. Kolańczyk (ed.) Samo się nie myśli. Afekt w procesach poznawczych. (pp. 70-105). Sopot: Smak Słowa.

Roczniewska, M., & Kolańczyk, A. (2014). Competence over communion. Implicit evaluation of personality traits during goal pursuit. *Polish Psychological Bulletin. 45(4)*, 418–425.

Roskos-Ewoldsen, D. R., Fazio, R. H. (1992). On the orienting value of attitudes: Attitude accessibility as a determinant of an object's attraction of visual attention. *Journal of Personality and Social Psychology, 63, (2)*, 198–211.

Schouppe, N., Braem, S., De Houwer, J., Silvetti, M., Verguts, T., Ridderinkhof, K. R., & Notebaert, W. (2015). No pain, no gain: the affective valence of congruency conditions changes following a successful response. *Cognitive, Affective, & Behavioral Neuroscience, 15*, 251–261.

Schouppe, N., De Houwer, J., Ridderinkhof, K. R., & Notebaert, W. (2012). Conflict: Run! Reduced Stroop interference with avoidance responses. *Quarterly Journal of Experimental Psychology, 65, (6)*, 1052–1058.

Schultheiss, O. C., & Brunstein, J. C. (1999). Goal imagery: Bridging the gap between implicit motives and explicit goals. *Journal of Personality*, *67*, 1, 1–37.

Schwarz, N. & Bless, B. (1991). Happy and mindless, but sad and smart? The impact of affectives states on analytic reasoning. In J. P. Forgas (Ed.), *Emotion and Social Judments* (pp. 55–71). London: Pergamon.

Semin, G. R., Higgins, T., de Montes, L. G., Estourget, Y., & Valencia, J. F., (2005). Linguistic signatures of regulatory focus: how abstraction fits promotion more than prevention. *Journal of Personality and Social Psychology*, *89*, 36–45.

Shah, J., & Higgins, E. T. (1997). Expectancy × value effects: Regulatory focus as determinant of magnitude and direction. *Journal of Personality and Social Psychology*, *73*, 447–458.

Shah, J. Y., Kruglanski, A. W. (2003). When opportunity knocks: Bottom-up priming of goals by means and its effects on self-regulation. *Journal of Personality and Social Psychology, 84, (6)*, 1109−1122.

Shalley, C. E., & Oldham, G. R. (1985). Effects of goal difficulty and expected external evaluation on intrinsic motivation: A laboratory study. *Academy of Management Journal, 28,* 628–640.

Silvetti, M., Seurinck, R., & Verguts, T. (2011). Value and prediction error in medial frontal cortex: Integrating the single-unit and systems levels of analysis. *Frontiers in Human Neuroscience, 5,* 75.

Smith, E. E., & Kosslyn, S. M., (2009). *Cognitive Psychology. Mind and brain*. New Jersey: Pearson education Inc./Pearson Prentice Hall.

Spiegel, S., Grant-Pillow, H., & Higgins, E. T. (2004). How regulatory fit enhances motivational strength during goal pursuit. *European Journal of Social Psychology, 34*, 39–54.

Summerville, A., & Roese, N. J. (2008). Self-report measures of individual differences in regulatory focus: A cautionary note. *Journal of Research in Personality*, *42*, 247–254.

Śmigaszewska, K., Szymura, B., & Słabosz, A. (2004). Przerzutność uwagi – rola procesów kontrolnych i automatycznych w powstawaniu kosztów przełączania się pomiędzy zadaniami. *Studia Psychologiczne, tom specjalny – Oblicza uwagi, 42 (1)*, 57–70.

Unsworth, N., Redick, Th. S., Spillers, G. J., & Brewer, G. A. (2012). Variation in working memory capacity and cognitive control: Goal maintenance and microadjustments of control. *Quarterly Journal of Experimental Psychology*, *65 (2),* 326–355.

Unsworth, N., Schrock, J. C., & Engle, R. W. (2004). Working memory capacity and the antisaccade task: Individual differences in voluntary saccade control. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*, 1302–1321.

Van-Dijk, D., & Kluger, A. N. (2004). Feedback sign effect on motivation: Is it moderated by regulatory focus? *Applied Psychology: An International Review*, *53*, 113–135.

Wallis, J. D., & Kennerley, S. W. (2010). Heterogeneous reward signals in prefrontal cortex. *Current Opinion in Neurobiology*, *20*, 191–198.

Wegner, D. M., & Erber, R. (1992). The hyperaccessibility of suppressed thoughts. *Journal of Personality and Social Psychology*, *63*, 903–912.

Winkielman, P., Berridge, K. C., & Wilbarger, J. L. (2005). Unconscious affective reactions to masked happy versus angry faces influence consumption behavior and judgments of value. *Personality and Social Psychology Bulletin. 31*, 121–135

Wytykowska, A., Białaszek, W., & Ostaszewski, P. (2014). Psychometryczne właściwości polskiej wersji krótkiej skali wrażliwości na kary i nagrody (SPSRQ-SF Cooper i Gomez, 2008), *Studia Psychologiczne, 52 (2)*, 28–39.

Zadra, J. R., Clore, G. L. (2011). Emotion and perception: the role of affective information. *WIREs Cognitive Science*.