Interaction between emotional context-guided shifting and cognitive shifting: Introduction of a novel task

Brigitte Biro[1,2,3,5], Gyongyi Kokonyei[2,3,4], Raissa de Oliveira Negrao[1,2], Adel Dancsik[2], Szilvia Karsai[1,2], H.N. Alexander Logemann[2] and Renata Cserjesi[2]

[1] *Doctoral School of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary*
[2] *Institute of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary*
[3] *SE-NAP2 Genetic Brain Imaging Migraine Research Group, Hungarian Academy of Sciences, Semmelweis University, Budapest, Hungary*
[4] *Department of Pharmacodynamics, Faculty of Pharmacy, Semmelweis University, Budapest, Hungary*
[5] *Department of Clinical Psychology, Semmelweis University, Budapest, Hungary*

Aim: Task shifting is considered as a critical component of cognitive flexibility that underlies the ability to flexibly switch between tasks. It is measured by performance-based tasks, where participants have to select/ignore simple target stimuli such as letters, numbers, or words according to certain rules. However, in everyday life individuals need to manage and shift between more complex, often emotionally charged stimuli. Previous paradigms developed to measure affective flexibility are based on the task where the focus is to shift between emotional and non-emotional stimuli, instead of the flexible shift between emotional valences. In view of this, the aim of the present study was to develop the Emotional Shifting Task, a novel paradigm that is created with the purpose of assessing emotional flexibility abilities by means of a novel valence-specific shifting design. Furthermore, scientific discussion regarding the relationship between cognitive and emotional flexibility abilities, a connection that is rarely addressed in the literature would be addressed. **Method:** In the present paper, task shifting was assessed by means of the Task Switching Task while the Emotional Shifting Task method evaluated emotional flexibility abilities in an online setting. **Results:** The results revealed a significant, positive relationship between task shifting and emotional shifting from positive to negative images only. Furthermore, when fast and slow performers on TST were distinguished results showed that fast performers on TST were also faster on EST shift conditions in general, but not on EST non-shift condition. **Conclusion:** These findings indicate that cognitive and emotional flexibility abilities may be interrelated. Our results seem to indicate a connection between the two shifting abilities.

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INTRODUCTION

Cognitive flexibility is the ability to flexibly change between concepts or mental processes, a core dimension of executive functions that allows adjusting the behaviour to changing environmental demands (Buttelmann & Karbach, 2017; Dajani & Uddin, 2015; Scott, 1962). Task-shifting is considered by some researchers as a lower-level form and one of the main components of cognitive flexibility (Bunge & Zelazo, 2006; Wang, Chen, & Yue, 2017). Task-shifting specifically refers to a type of cognitive flexibility assessment in which subjects are required to switch between tasks according to different instructions and based on several, provided stimuli (Dajani & Uddin, 2015; Monsell, 2003).

The ability of task-shifting can be assessed using classical paradigms of cognitive psychological tests such as task-shifting (Rogers & Monsell, 1995), Stroop Switch Task (Hutchison, Balota, & Ducheck, 2010; Stroop, 1992), and Trail Making Tasks (Corrigan & Hinkeldey, 1987; Md, 2004). These tasks share similarities in the sense that during the performance simple target forms (letters, numbers, or words) need to be selected or ignored according to certain rules that change with specific context (spatial position, color or sequencing order).

Unlike in a laboratory setting, people in everyday life face more complex stimuli than letters and numbers which they need to shift between and most of these stimuli are emotionally charged, as well. Emotional stimuli are highly relevant for us and the emotional significance of a stimulus enhances its processing (Kauschke et al., 2019). If so, do we use the same process to shift between stimuli when they carry emotional valence embodied in a context compared to those without emotional value?

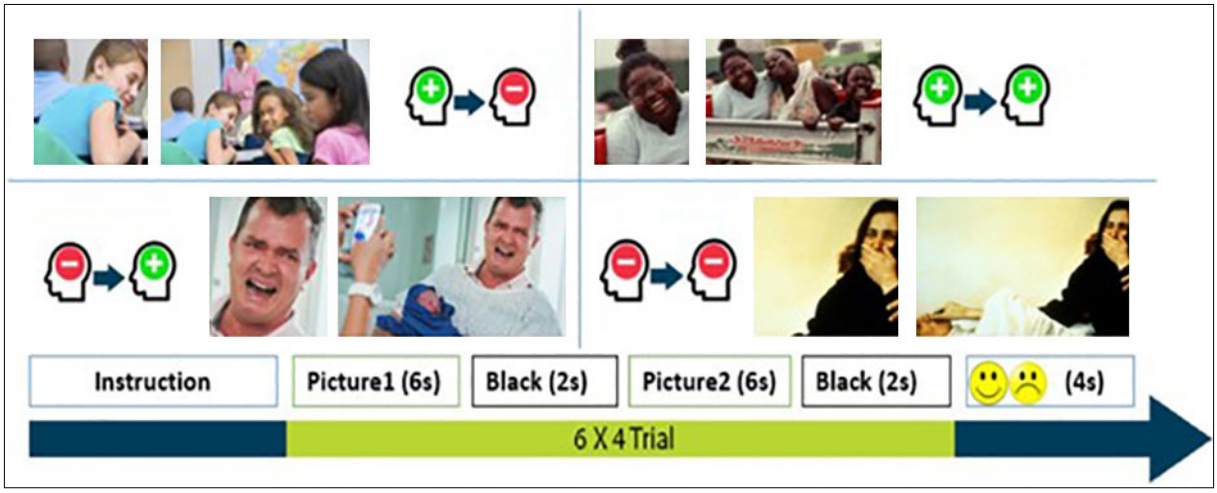
In everyday life, individuals need to continuously select and switch between stimuli varying in valence. Amongst these varieties of emotional information, one encounters stimuli embodied in context. Keeping this in mind, we have developed a new paradigm called the Emotional Shifting Task (EST) which will measure the ability to shift from a stimulus with a positive valence to one with a negative valence. Besides creating sets based on their oppositional emotional value, the context sensitivity has been also considered that will emphasize the importance of shifting emotional outputs based on varying, emotionally evocative contextual changes (Coifman & Summers, 2019).

Several methodological approaches were taken into consideration while designing the EST with regards to the already existing assessments of emotional flexibility. Emotional flexibility refers to the ability to modify emotional responses in a way to fit the constantly changing environmental context, hence to alter a primary emotional response to correspond to the demands of different contexts (Beshai et al., 2018; Waugh, Thompson, & Gotlib, 2011). According to this definition, one of the cardinal features' of emotional flexibility is context sensitivity, that was greatly considered when creating the EST as well as context-sensitive paradigms that contain several advantageous features, such as a complex, multidimensional perspective of emotional flexibility that captures spontaneous, deliberate, implicit, and involuntary emotional responses without giving explicit indications to the participants regarding an expected type of regulation (Coifman & Summers, 2019).

Studies that examine emotional flexibility have utilized a wide variety of methodological approaches spanning from simple self-report questionnaires and interviews to complex task-based paradigms. However, in terms of the evaluation and study of this domain, substantial research still needs to be done. In the area of self-reports, Fu et al. (2018) developed the Emotional Flexibility Scale which consists of eighteen items designed to assess an individual's ability to regulate positive and negative emotions in response to internal and external contexts. Coifman and Bonanno (2010), for example, combined semi-structured narrative interviews with negative- and positive-effect ratings in order to assess context sensitivity and emotional responsiveness. Standardized tasks are scarce and mainly performance-based (Fu et al., 2018), as capturing and creating a context, especially in its fluctuating nature, in laboratory circumstances is challenging. Thus, the need remains to have a psychological measure that captures contextual changes in a way that more closely approaches "real life" circumstances that can be reflected by complex contextual backgrounds. The present study contends that a task in which using positive versus negative emotional stimuli would be an ideal instrument for evaluating emotional flexibility, since this approach would represent a basic emotional polarity, as emotional flexibility itself refers to the ability to shift between both negative and positive emotions.

To assess shifting between emotional and non-emotional sets, some paradigms have already been created. De Lissnyder et al. (2012) developed the Internal Shift Task (IST) consisting of emotional

Figure 1. Example of Shift and Non-shift Conditions of the EST:
The head-shaped pictograms by the pair of pictures indicate the direction of the shift. (Adobe Illustrator CC)



faces (angry and neutral) to measure reaction time in switching and non-switching conditions when participants needed to respond either to the facial expression (emotional condition) or gender (non-emotional condition). Beckwé et al. (2014) used a modified version of IST including emotional words (negative and neutral) instead of pictures. The limitation of IST is that it included only negative and neutral stimuli, and assessment focused mainly on the difference switching cost between emotional and non-emotional conditions.

Another paradigm that assesses the effect of emotional content on shifting is the Emotional Stroop Task (Ben-Haim et al., 2016; Song et al., 2017). A typical finding regarding this task was that naming the color of an emotional content requires more time, than naming the color of the non-emotional one (Ben-Haim et al., 2016). However, this latency effect refers rather on how emotional meaning of the words may interfere implicitly with cognitive color naming processing and not specific for emotional shifting.

Another important and an original approach to assess affective flexibility with an affective task switching paradigm was published by Genet et al. (2013). In their novel paradigm, words were used as stimuli. Following the design of the classical task switching task, the presented emotional stimuli were required to be switched between two categorization rules, one being an affective rule (positive vs. negative word), the second a non-affective rule (adjective vs. noun). By using affective task switching and a regular task-switching task in regards with trait resilience, they concluded that affective flexibility seems to be separate from general cognitive flexibility. The affective task switching paradigm allows us to measure the difference in switching cost between emotional and non-emotional conditions regarding both for negative and positive valences, however it does not provide us an insight about the actual switch between positive vs. negative emotional valences.

A growing number of studies conducted with the aim of exploring emotional flexibility demonstrate this advantage (Beshai et al., 2018; Fu et al., 2018; Malooly et al., 2013; Ochsner et al., 2012; Wang et al., 2017; Waugh et al., 2011). For instance, Waugh et al. (2011) created a traditional "viewing and rating" task to study context-dependent emotional responses while additionally utilizing positive and negative IAPS pictures to create an emotionally evocative context. Affective responses were registered based on how participants rated pictures when viewing the stimuli.

These previously used, context-sensitive measures, self-reported or task-based as well, have factors that left a few issues to be addressed. Firstly, it cannot be forgotten that throughout many tasks participants were explicitly instructed what to do with the emotional stimuli either during the task or in the process of self-reporting (i.e., to rate it on a scale, reappraise it, etc). Secondly, a visually-presented set of pictures were independent from one another, therefore the changing nature of the context could not be addressed. Thirdly, the large number of stimuli presented could create an attentional capacity load in the results, an aspect for which no control has been previously provided. Lastly, but most importantly, these studies show that examining emotional flexibility also demands an awareness of the inference of cognitive flexibility functions; even though these

two constructs are conceptually and functionally distinct, their function seems to affect one another.

Thus, the EST was designed in a way that takes into consideration the general idea behind classic cognitive paradigms and implements the advantages of previous context-sensitive emotional flexibility assessments. Therefore, during the EST participants are presented with trials that include a set of stimuli such as a cropped picture (part of a scenario) with either a positive or negative valence that is followed by the complete picture including context (whole scenario) which has the same or opposite valence relative to the first picture. The cropped picture shows a single emotional entity – for example a crying male face – while the complete picture shows the face in context -such as, the same man getting married (Figure 1). The task is that in certain trials there is a shift in the valence, while in other trials there is no shift in valence. Participants are required to indicate, by button press, the valence of the stimuli in the given trial. In our task, context serves as an implicit cue that adds extra emotional information and urges the process of shifting. A novelty of our task is that it not only implements the advantages of a context sensitive paradigm but was designed to reflect the constantly changing and complex nature of the context, just as it would appear in "real-life" circumstances.

However, how one reacts to "real-life" circumstances might also be influenced by psychological distress. Bradley et al. (1995) found evidence that higher anxiety levels can lead to a bias toward negative information processing on an unconscious level. They found that patients with generalized anxiety disorder performed slower on a color- naming task when the presented word was emotionally negative. A meta-analysis (Bar-Haim et al., 2007) also evidenced that people with higher anxiety levels are emotionally biased toward threatening, thus negative information.

Therefore, the present study aimed to measure how the context guided emotional shifting based novel paradigm, the EST, may correlate with classical set-shifting tasks such as Task-Switching Task (TST). We assumed that those who performed better on the TST, would also perform better on the EST. As anxiety and negative mood may affect shifting performance, specifically when emotional cues are involved, we have taken it into account. During the study the Depression Anxiety Stress Scales (DASS-21) questionnaire was used to assess participants' recent psychological distress to provide more comprehensive information about their emotional state. The questionnaire allowed us to control for participants undergoing excessive affective state and additionally to explore whether the performance on EST is influenced by affective state that occurred at the time of the test or throughout the course of a week.

To this end, we therefore conducted an online study however, before initiating it, pilot studies were carried out in order to select the stimuli for the EST.

METHODS

Pilot Studies

Two pilot studies were conducted in order to develop the task that was later used in our Study. To overcome the issues pointed out in the preceding review of the literature, we developed the Emotional Shifting Task (EST) for the purpose of assessing emotional shifting in a way that is meant to represent the constantly changing and highly complex nature of the context in "real-life" circumstances. It was also aimed to create a context-sensitive paradigm that applies the benefits of representing basic emotional polarities by using positive versus negative and negative versus positive emotional stimuli. Pilot studies were therefore conducted to select the most feasible set of stimuli. Intended to be used in pairs, the stimuli that were to be selected were first presented without a contextual background (a cropped-out detail), then displayed a second time after having been placed back in the context (the whole picture). The context was also required to change the valence of the cropped version of the picture, thus creating positive-to-negative and negative-to-positive shifting conditions. The widely used IAPS pictures (International Affective Picture System) (Lang et al., 1998) were not feasible for shifting conditions, as none of them could be cropped in a way to present the positive/negative and negative/positive polarity within one picture. IAPS pictures (that were the same/near the same quality as the ones used in the shift conditions), were used in the control conditions where shifting was not expected.

The pilot tests of the stimuli used in the EST

To verify whether the images selected from the Internet (Google search) were suitable for our paradigm, a short, pilot study was conducted online on forty-six healthy adults (mean age: 32.54, SD: 16.36; 37 females, 9 men). The stimuli were presented in Google Forms and participants were asked to rate the pictures in a way that is similar to how IAPS pictures are rated, i.e., on seven-point Likert scale by valence (1-very

Table 1. Mean values of valence and arousal for the original EST pairs of pictures

	Valence			Arousal		
	Picture 1 Mean (SD)	**Picture 2** Mean (SD)	**Diff**	**Picture 1** Mean (SD)	**Picture 2** Mean (SD)	**Diff**
Positive	4.12 (.89)	3.03 (0.95)	Z=-5.93 p<0.001	3.25 (1.17)	3.99 (1.3)	Z=-6.03 p<0.001
Negative	3.57 (1.07)	4.09 (1.40)	Z=-2.25 p=0.02	3.60 (1.2)	4.16 (1.32)	Z=-4.85 p<0.001

Non-parametric statistics were used, as the data was not normally distributed: Z values are from the 2 related samples Wilcoxon probe.

unpleasant, 7-very pleasant) and arousal (1-boring, 7-very intense). The ratings were separately required for the whole picture (Picture 2) and its cropped version (Picture 1). To fit the shifting condition, only those pairs of pictures were selected in which Picture 1 and Picture 2 differed significantly in the valence ratings. Subsequently, fourteen pairs of pictures were selected. These fourteen pairs of pictures were rated by ninety-one participants (mean age: 31.08, SD: 12.04; 40 men). These images showed a significant difference regarding their mean value of valence in both positive-to-negative and negative-to-positive conditions.

Figure 1 provides an example of the paired images used in the course of our study; the first picture displays a part (cropped-out version) of the second picture, resulting in an omission of context. Presenting the second picture aids the essential context, thereby resulting in either a change or no change in valence.

When shifting from positive to negative or negative to positive, the mean value of the valence ratings were significantly higher for positively valenced pictures compared to negatively valenced stimuli. Meanwhile, the mean values of the arousal ratings were significantly higher when the second image was presented, irrespective of whether it was positive or negative. This result indicates the arousing effect of extra contextual information (Table 1). Stimuli used in the non-shifting condition were selected from the IAPS pictures (12 in total) as they were suitable for positive-to-positive and negative-to-negative conditions.

Study

In the present study (conducted online), the aim was to investigate the possible relationship between EST paradigm and the computer-based Task Switching Task. To obtain precise information in connection to participants' emotional state, the Depression Anxiety Stress Scales (DASS-21) were implemented. Thus, we explored whether negative feelings such as depression, anxiety might be related to the performance on EST.

Participants

One hundred-eighteen people participated in the online study. After excluding outliers, the data for one hundred-six individuals (47 males, age range 18-52 years old (M=25.7; SD=5.41) were included in the analysis. Only five of one hundred-six participants had not completed their secondary school education (due to age) and ninety participants had either BA or MA level university degrees.

Measures

EST: An online platform the Psytoolkit Webserver located in Strasbourg (Stoet, 2010, 2017) featuring the EST was used to assess emotional shift. Participants were asked to respond regarding whether the presented picture was positive or negative; responses were to be given after each picture (Picture 1 & Picture 2) by pressing a key on the computer's keyboard. One specific keyboard corresponded to the sad smiley and another one to the happy smiley and this was consistent throughout the whole task. Four practice trials were held before the actual eighteen trials started; if the participants answered incorrectly or spent more than three seconds without providing an answer, they were informed by feedback on the screen and the given answer was considered wrong. Out of the eighteen images in total, nine begin as positive and nine as negative. Half of the trials presented the two switching conditions mentioned previously, while the other half demonstrated non-switching conditions. The images possessed a resolution of 800 x 550 pixels. Responses that were either shorter than 300 ms or longer than 3000 ms were considered incorrect. In EST, data on the reaction time (RT) of the correct

Table 2. Displays the descriptive data (mean, Std. Deviation) on DASS-21 questionnaire's subscales, mean RT of TST and EST conditions

	Minimum	Maximum	Mean	Std. Deviation
Depression	0	40	9.94	9.00
Anxiety	0	30	8.83	7.29
Stress	0	32	12.77	7.43
TST Switch RT$_1$	849.80	3051.23	1608.72	418.03
TST Non-Switch RT	538.95	2930.73	1134.72	349.87
EST shift RT$_2$	461.00	2133.00	1370.61	313.22
• 1st picture positive RT	771.00	2506.00	1458.54	368.06
• 1st picture negative RT	930.00	2432.00	1455.09	334.82
• 2nd picture positive RT	390.00	2828.00	1513.52	382.36
• 2nd tpicture negative RT	461.00	2433.00	1228.84	352.04
EST the NON-shift RT$_3$	415.00	2254.25	1323.42	329.55
• 1st picture negative RT	819.00	2418.00	1495.65	321.01
• 1st picture positive RT	734.80	2046.50	1247.54	275.45
• 2nd picture negative RT	463.00	2643.00	1537.79	459.63
• 2nd picture positive RT	415.00	2113.50	1129.25	285.54

$_1$RT is measured in millisecond (ms)
$_2$Emotional Shifting Task, mean RT in ms of the two shift conditions positive to negative and negative to positive.
$_3$Emotional shifting Task mean RT in ms of the two non-shift conditions positive to positive and negative to negative.

responses were independently collected for the first (Picture 1) and the second (Picture 2) exhibited by a pair of pictures.

Task shifting was evaluated by means of the Task-Switching Task (TST) developed by Rogers and Monsell (1995). This task consists of stimuli always presented as a letter and a number, both together and randomly, in one of four quadrants of the screen, for example, "G6." Participants were to answer based on four conditions consisting of two classifications of letters (vowel or consonant) and two classifications of numbers (even or odd). When the image of letter and number appeared in the top quadrants, only the letter must be considered; participants respond by pressing the letters "B" or "N" on the keyboard, with "B" corresponding to consonants and "N" to vowels. When the image appeared in the bottom quadrants, only the number must be considered and participants could respond by once again pressing either "B" or "N" on the keyboard, only this time the letters referred to odd or even numbers, respectively (Lien et al., 2003; Monsell, 2003). The task is divided into three parts. The first two parts comprise non-shifting conditions, when there is no shifting from letters to numbers. In the third part, in the shifting condition the shift from letters to numbers was required. In case of mistakes, feedback regarding the correct demand was provided instantly. The same error message appeared if participants did not respond within five seconds of the stimuli being shown. In our study, the mean reaction time for correct responses for shifting (TST shifting) and non-shifting conditions (TST non-shifting) were used.

The Depression Anxiety Stress Scales (DASS-21) is a scale consisting of twenty-one items that was designed to assess the levels of depression, anxiety and stress (Henry & Crawford, 2005). The online version (www.psy.unsw.edu.au/dass) assesses symptoms exhibited by participants during the preceding week on a 0 to 3 Likert scale. The three subscales contain seven items, with each containing a similar content. This test therefore provided us with information about recent emotional distress (e.g. "I tended to over-react to situations"). Studies have established the use of DASS-21 among non-clinic individuals and confirmed its reliability in evaluating distress among the general population (Henry & Crawford, 2005; Osman et al., 2012). The reliability of the subscales included in the questionnaire are 0.88 for Depression, 0.82 for Anxiety and 0.90 for Stress. Reliability for the total scale is 0.93 (Henry & Crawford, 2005). In our study, we used the subscale results for Depression (D), Anxiety (A) and Stress (S).

Procedure

The experiment was conducted via the platform hosted by the Psytoolkit Webserver located in Strasbourg. Psytoolkit Webserver was chosen due to its qualities as a non-costly, reliable and simple platform that was created specifically for cognitive/psychological studies (Stoet, 2010, 2017). All participants provided

Table 3. The Correlation between EST, TST, and DASS=21 factors

	TST switch	TST NON-switch	Depression	Anxiety	Stress
EST shift RT's$_1$	**0.248***	**0.206***	-0.097	0.106	0.000
• 1st picture positive	-0.059	-0.115	0.032	0.149	0.056
• 1st picture negative	-0.031	-0.001	-0.095	-0.020	-0.056
• 2nd picture negative	**0.289****	**0.224***	-0.169	0.002	-0.082
• 2nd picture positive	0.089	0.053	-0.026	0.179	0.105
EST NON shift RT's$_2$	0.124	0.027	-0.074	0.185	0.119
• 1st picture negative	-0.016	0.087	-0.118	0.087	0.022
• 1st picture positive	0.092	0.132	-0.027	0.131	0.025
• 2nd picture negative	0.111	-0.006	-0.032	0.163	0.120
• 2nd picture positive	0.156	0.100	-0.064	0.186	0.087

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
$_1$Emotional Shifting task, mean RT of the two shift conditions positive to negative and negative to positive.
$_2$Emotional shifting Task mean RT of the two non-shift conditions positive to positive and negative to negative.

their informed consent prior to participation. The study was approved by the local Research Ethics Committee. The time required for completion of the experiment was approximately thirty minutes.

Statistical analyses

Descriptive statistics were carried out using the scores on the DASS-21 subscales, the reaction time and accuracy of the TST and the mean reaction time values (only correct answers included) for each condition of the EST. Data on RT were not normally distributed, thus non-parametric Spearman's correlations were carried out to examine the possible relationship between our outcome values. Finally, with the aim of exploring possible predictors for emotional shifting, linear regression analyses were carried out. Significance were found in the following models: During the first analysis the EST switching RTs (mean RT on second Picture if the valence for the second Picture was different from the first Picture) were included as dependent variables and TST and Depression were added as independent variables. Afterwards, the EST switching RTs were included once again as dependent variables and TST and Anxiety were included as independent variables. This design was in order due to the strong correlation of the Depression and Anxiety subscales that would cause false significant connection in the linear regression model. The second model included RTs on positive-to-negative switching (mean RT on all of the second pictures with negative valence, if it was preceded by positively valenced first pictures) as dependent variables, whereas independent variables included the mean RT results of TST switching and non-switching conditions, level of depression, anxiety, and stress. Due to limited variability in the number of correct responses, we only used reaction time data in all our analyses.

To examine if fast shifters, compared to slow shifters on the TST show a better (or worse) performance on EST and to study if this performance could change as a function of the perceived distress, Generalized Linear Model, robust estimation method was used.

Results

Descriptive statistics

To gain an overview of the performance on all instruments, descriptive statistics were performed using IBM SPSS 25 (IBM SPSS, IBM Corp., Armonk, NY). Mean, SD and range were calculated using scores on the DASS-21 subscales, the speed of the TST, and the mean reaction time each condition of the EST (Table 2). As the accuracy results of the tasks had a very low variance (only a few participants made mistakes likely due to healthy mental record and high educational level), therefore only reaction times (speed) were included in the statistical analyses.

The relationship between TST and EST

Table 3 indicates the presence of a significant positive correlation between the performance on TST and EST in connection to shifting conditions. This result means that those participants who performed more slowly on TST also performed more slowly on EST when they needed to change flexibly between targets. Performance on EST shifting conditions is

Table 4. Emotional shift predictors

Dependent variable	Independent variables	B	Beta	T	P
MODEL 1					
Model 1A: *EST shift RT (mean of the negative-to-positive and positive-to-negative conditions)*	TST Switch	0.192	0.257	2.677	0.009
	Depression	-2.502	-0.072	-0.752	0.454
Model 1B: *EST shift RT (mean of the negative-to-positive and positive-to-negative conditions)*	TST Switch	0.198	0.265	2.797	0.006
	Anxiety	4.761	0.111	1.174	0.243
MODEL 2					
Positive-to-negative shift RT	TST Switch	0.273	0.296	3.109	0.002

Model 1A R = 0.100, R square 0.010, F = 0.504, p = 0.605,
Model 1B R = 0.261, R square 0.063, F = 4.659, p = 0.012,
Model 2R = 0.296, R square 0.087, F = 9.663, p = 0.002

positively correlated to the performance on non-shifting conditions of the TST. Therefore, those who performed more slowly in non-shifting conditions of TST also performed more slowly in EST shifting. When we explored this relationship separately for negative and positive conditions, we found a significant relationship between task shifting performance and the speed of shifting from positive-to-negative pictures. These relationships were not found for the shift from negative to positive. When we explored this connection between the RTs given for the pictures presented first (before shifting), this connection was not found. Furthermore, no significant correlations were found between DASS-21 subscales and EST.

Predictors of EST

Table 4 indicated that the performance on emotional shifting independently to the emotional values can be significantly predicted only by the performance on the TST switching and emotional state such as depression and anxiety did not predict the RI performances on the EST shifting condition. As the significance level between the Anxiety and the Depression subscales were high (r=0.68) these two variables had to be added as separate independent variables during the regression analyses. When we used a positive-to-negative shift as a dependent variable, we found that only the switching speed during the TST (switch condition) task can significantly predict emotional shifting speed. RT was measured in milliseconds.

Distinguishing faster and slower performers

To examine if fast shifters (N=53; RI>1522.809), compared to slow shifters (N=52; RI<1522.809), show a better (or worse) performance on EST and to study if this performance could change as a function of the perceived distress, Generalized Linear Model, robust estimation method was used. When splitting participants in two groups by their median (1522.809) in their cognitive switch (TST) RT values we found that grouping had an effect on EST shifting values (Table 5). Namely, faster performers on TST switch conditions were indeed faster in EST shift conditions, but this affect was not observed in EST non-shift conditions, meaning that fast performers in TST switch were not faster in EST non-shift. Then adding as separate covariates the Depression and Anxiety (Table 5) subscales and found that neither Depression nor Anxiety had an effect or interaction to the TST groupings (fast or slow performers) or the EST shifting performance. This further supports our hypotheses that there might be a connection between cognitive and emotional shifting functions that is not effected by psychological distress.

DISCUSSION

The aim of the reported research was to introduce a novel task that effectively evaluates emotional shifting. The novelty of our study lies in its reliance upon an approach, the Emotional Shifting Task (EST) that aims to assess emotional flexibility and its fluctuating nature within a less rigid laboratory setting. The advantages of the Emotional Shifting Task are that it is an implicit evaluation tool that includes and uses the context which serves as a passive cue in order to create both positive and negative, emotionally evocative stimuli. Furthermore, this study aimed to fill the gap in the literature regarding the comparison of two abilities that play an important role in individuals' everyday lives. Moreover, the present paper discussed the connection between emotional and cognitive shifting abilities and to assess psychological distress

Table 5. Displays the effect of TST fast/slow groups on EST shift condition Depression and Anxiety

Dependent variables	Independent variables	Wald Chi-Square	df	p
EST & TST				
EST shift RT *(mean of the negative-to-positive and positive-to-negative conditions)*	TST switch RT (fast/slow groups)	8.435	1	0.004
EST & TST & Depression				
EST shift RT *(mean of the negative-to-positive and positive-to-negative conditions)*	TST switch RT (fast/slow groups)	5.812	1	0.016
	Depression	1.093	1	0.296
	TST switch RT (fast/slow groups)* Depression	.137	1	0.771
EST & TST & Anxiety				
EST shift RT *(mean of the negative-to-positive and positive-to-negative conditions)*	TST switch RT (fast/slow groups)	2.767	1	0.096
	Anxiety	1.274	1	0.259
	TST switch RT (fast/slow groups) * Anxiety	.131	1	0.718

and explore its possible impact on emotional shifting, individual's level of anxiety, stress or depression was assessed. Due to the novelty of this task, our results must be interpreted with great caution.

The main focus of our paper was to reveal that when it comes to a specific feature of cognitive and emotional processing, namely shifting, are these processes completely distinct or might overlap. To sum up the results presented above, it is indicated that emotional and cognitive shifting are two different flexibility systems even though there might be weak connections between the two. The above results suggest that in shifting from positive to negative, cognitive functions might interfere. However, shifting from negative to positive might be related to different processes.

Our hypothesis was only partially confirmed, as we found significant correlation between performance variables pertaining to the Task-Switching Task and Emotional Shifting Task. Specifically, the better participants performed the cognitive switching tasks in general, including both *switch* and *non-switch* conditions, the quicker performance they were able to give in the mean EST *shift condition* and EST *positive-to-negative shift* conditions according to our correlation analysis. Regression model revealed that speed of *positive to negative shifting* was significantly predicted by the *shifting performance on the TST shift condition* only and not the non-shifting condition of TST, thus the regression analysis confirmed our hypotheses. The hypothesis was further supported by the GLM analyses which showed that faster performers on *TST shift* condition were also faster on *EST shift condition* in general, but not on EST non-shift condition. Psychological distress seem not to effect the above results.

Cunningham et al. (2008) found evidence that negative emotional information is less flexibly processed compared to positive information. This might explain the lack of correlation between the cognitive switching task and the EST *negative-to-positive condition*, as presenting a negative picture first might have induced bias in the process of negative stimuli, thereby making it more difficult to shift one's emotions towards positive information. Several studies have reported results regarding how emotions effect cognitive flexibility abilities, a factor that might help us to understand the aforementioned result a little better. It is, however, important to note that these studies differed from ours regarding both their goals and design. Wang et al. (2017) used fMRI to indicate that positive emotions influence cognitive flexibility abilities when positive, negative and neutral images are presented before individuals complete a certain cognitive flexibility task. In this case, participants achieved better performance – resulting in faster reaction time (RT) – after positive stimuli were presented, whereas in trials using negative images as stimuli the results were inverse. This study also monitored brain activity and provided evidence that the dorsal anterior cingulate cortex dACC (linked to cognitive flexibility and conflict monitoring) (Botvinick et al. 2004) decreased its level of activation during switch trials in positive conditions and increased its activation during switch trials in negative condition. Similarly, several studies

found evidence that positive emotions exert a positive effect on responses during executive functioning tasks (Carvalho & Ready, 2010; Dreisbach, 2006; Van der Stigchel et al., 2011; Vásquez-Rosati et al., 2019). To verify whether this connection was indeed due to shifting in EST, we also analyzed RTs given to the picture presented first (before shift) and no such connection was detected.

Predictors of the performance observed during EST show an interesting pattern. Predictor of the performance on EST positive to negative condition was the performance observed on TST switch condition. This weak connection is positive showing that a good performance on TST switch condition implies a good performance on EST *positive-to-negative condition*. This might suggest that altering positive emotions into negative ones involves more cognitive processes than the other way around.

Last but not least, our results showed that faster performers in the cognitive shift task (TST shift condition) were also faster in the EST shift conditions (mean of the two shift conditions positive to negative and negative to positive).

LIMITATIONS AND OUTLOOK

Although the online format may be viewed as a potential limitation, we would like to emphasize that all possible measures were taken to verify the integrity of the obtained data. Several studies in the current literature for cognitive experimental psychology have specifically addressed the validity/reliability of online studies (Hilbig, 2016; Kim et al., 2007; Schubert et al., 2013; Stoet, 2017) and in general the data found in these studies support online data collection/online studies.

The arousal value of picture 1 and 2 were different in both switching conditions. This might be due to the fact that the emotional information in Picture 1 is simpler and more limited compared to Picture 2 that is more complex, thus can evoke higher arousal (See Table 1). This effect may be the same for the non-switching conditions as well, however we did not measure in the present study. However, in another study (in preparation) we did measure arousal for Picture 1 and Picture 2 on the non-switching conditions and find the same difference.

A further limitation may lie in the fact that participants were from different backgrounds; as it was an online data collection, participants originated from different countries, and had not all completed university. These differences could be reflected in their performance, a circumstance that requires further investigation and possible modification of the study design to accommodate the culturally diverse group and its reactions to different emotional shifting conditions, since interpretations and responses from participants regarding emotional images can differ. In addition to these aspects, further research is also recommended in the area of investigating brain activity for the purpose of locating neural bases for the different processes of shifting from positive to negative or negative to positive (manuscript in preparation), as several studies other than our own have also indicated a different processing style depending on changes in valence.

It also important to note here, as a limitation that the order of the tasks/questionnaires were not counterbalanced in the study presented above. The overall procedure was not very time consuming or tiering thus this might not have affected the performance of the participants.

CONCLUSION

The present paper introduced an exploratory study thus the results must not be interpreted as general conclusions as only weak correlations were found on a limited number of participants. Therefore, the connection between cognitive and emotional shifting abilities were only partially confirmed by the above studies. However, our results suggest that individuals who perform faster on cognitive shift tasks seem to attain a faster performance in the emotional shift tasks as reflected by RTs. Additionally, shifting from positive to negative seems to contain a somewhat cognitive aspect, as was predicted by the performance of the cognitive flexibility task.

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Corresponding author: Renata Cserjesi
Institute of Psychology, ELTE Eötvös Loránd University
1064 Izabella str. 46. Budapest, Hungary
E-mail: cserjesi.renata@ppk.elte.hu

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A kontextus-vezérelt érzelmi váltás és a kognitív váltás kapcsolata: egy új paradigma bemutatása

Célkitűzés: Kognitív flexibilitásnak azt a képességet nevezzük, amely lehetővé teszi, hogy a figyelmünk segítségével rugalmasan váltsunk különböző feladatok/ingerek/stratégiák között. Ennek egy fontos komponense a task shifting, amely olyan feladatotokat foglal magában, amelyek során a vizsgálati személyek egy előre megadott szabály alapján kiválasztanak vagy ignorálnak bizonyos célingereket (szám, betű, szó). A mindennapi élet során azonban, sokkal komplexebb, érzelmi jelentőséggel is bíró ingerekkel szembesülünk, amelyek között tudnunk kell rugalmasan váltani, ezt a képességet nevezzük érzelmi flexibilitásnak. Az érzelmi flexibilitás mérése korábbi kutatásokban olyan paradigmák mentén zajlott, amelyekben a váltás érzelmi és semleges (nem érzelmi) ingerek között történt, így az eltérő valenciájú érzelmi ingerek közötti rugalmas váltás képessége nem érhető tetten. Ennek tükrében a jelen kutatás célja egy új paradigma bemutatás, amely a valencia-specifikus érzelmi flexibilitás mérését tűzi ki céljául, az Érzelmi Váltás Feladaton keresztül. Továbbá, górcső alá veszi a kognitív és az érzelmi flexibilitás képessége között meghúzódó lehetséges kapcsolatot, amelyre korábbi szakirodalmak ritkán tértek ki. **Módszer:** A vizsgálat során a kognitív flexibilitás képességét a Task Switching Feladattal, míg az érzelmi flexibilitást az általunk fejlesztett Érzelmi Flexibilitás Feladattal ragadtuk meg. A kutatás online zajlott. **Eredmények:** Az eredményeink szignifikáns pozitív kapcsolatot mutatnak az érzelmi és kognitív flexibilitás között abban az esetben, amikor pozitív érzelmi valenciájú ingerről negatív valenciájú ingerre történt az érzelmi váltás. Továbbá, azon vizsgálati személyek, akik a kognitív váltás feladatban gyorsak voltak, az érzelmi váltás feladatban a váltás kondícióiban is gyorsabban teljesítettek (a kontroll kondícióknál, ahol nem volt váltás az ingerek érzelmi valenciájában ez az eredmény nem volt kimutatható). **Konklúzió:** Eredményeink a kognitív és az érzelmi flexibilitás képességek esetleges kapcsolatára mutat rá kognitív és az érzelmi váltás feladatokon keresztül.

Kulcsszavak: érzelmi valencia, task-switching, flexibilitás, Érzelem Váltás Feladat, pszichés distressz