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Time to be smart: Uncovering a complex interplay between intelligence and time perspectives

Marcin Zajenkowski *, Maciej Stolarski, Oliwia Maciantowicz, Marta Malesza, Joanna Witowska

Faculty of Psychology, University of Warsaw, Poland

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ABSTRACT

In the present studies we examine complex relationships between time perspective (the characteristic way in which an individual partitions the flow of personal experiences into time-bound categories; TP) and cognitive ability. Additionally, we consider cognitive, emotional and motivational mediators of these associations. In study 1 (n = 238) we measured TP, fluid and verbal intelligences as well as subjectively assessed intelligence. Past Negative and Present Fatalistic TPs correlated negatively with fluid and verbal intelligences. Present Hedonism was negatively, and Future TP positively, associated with verbal intelligence. Subjectively assessed intelligence mediated the relationship between Present Fatalism and intelligence. Finally, Balanced TP positively correlated with fluid intelligence. Study 2 (n = 306) revealed that Present Fatalism and Past Negative were associated with higher stress related to intelligence-test performance, while Balanced TP reduced this stress. The obtained results suggest that TP may play a significant role in acquiring abilities (crystallized intelligence), but also that it probably influences test performance.

1. Introduction

Studies on intelligence have usually considered time in terms of task performance speed (Jensen, 2006). Recently, an increasing interest in the construct of time perspective (TP) as a robust predictor of many real-life outcomes has been observed (see Stolarski, Fieulaine & van Beek, 2015). TP is a relatively stable characteristic describing the way in which an individual partitions the flow of personal experiences into time-bound categories, or time zones, that becomes part of the personality (Zimbardo & Boyd, 1999). Interestingly, both intelligence and time perspective have been shown to correlate with a variety of psychological variables, such as health (Deary & Gottfredson, 2004; Guthrie, Butler & Ward, 2009), gratification delay (Shamosh & Gray, 2008; Stolarski, Bitner & Zimbardo, 2011), aggression (Zimbardo & Boyd, 1999; Zajenkowski & Zajenkowska, 2015), educational outcomes (Alansari, Worrell, Rubie-Davies, & Webber, 2013; Deary, Strand, Smith, & Fernandes, 2007), and job performance (Gottfredson, 1997a; Seijts, 1998), among many others. These similarities prompt the question of whether and how these seemingly distinct constructs are related. Zimbardo and Boyd (1999) explicitly stated that the process of temporal framing is predominantly cognitive; moreover, TP has been described as a regulatory mechanism that may allow for adaptive regulation of one's psychological states (Stolarski et al., 2014; Matthews & Stolarski, 2015). In other words, TP can be analyzed both as a process emerging from intellectual abilities, as well as a disposition (or a set of dispositions) that allow individuals to effectively regulate their own psychological states (e.g., levels of stress, motivation, etc.; see Matthews & Stolarski, 2015) in order to optimize their cognitive performance. Thus, the aim of the present study was to empirically analyze associations between TP and intelligence, as well as to provide some insight into mechanism of these relationships. Such analyses could allow to better understand the nature of intelligence by broadening its nomological network and to identify some novel mechanisms influencing the effectiveness of cognitive processing. Besides some preliminary investigations (Zajenkowski, Carelli & Ledzińska, 2015), to date no systematic research has analyzed the cognitive mechanism underlying or resulting from TP. In the present study we examine the complex relationships between TP and cognitive ability in order to gain a deeper understanding of their nature. Additionally, we consider other variables, from cognitive, emotional and motivational levels, that might mediate these relationships.

1.1. Time perspective

Defined as "the often non-conscious process whereby the continual flows of personal and social experiences are assigned to temporal

* Corresponding author.
E-mail address: Zajenkowski@psych.uw.edu.pl (M. Zajenkowski).

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categories, or time frames, that help to give order, coherence, and meaning to those events" (Zimbardo & Boyd, 1999, p. 1271), TP can be considered as a process; an online way of cognitive framing of experience, and as a trait; a stable, habitual focus on a particular temporal frame, i.e. the past, the present or the future. How individuals approach this sense of psychological time has far-reaching cognitive, affective and motivational consequences (Stolarski, Wiberg & Osin, 2015). Therefore, it becomes important to consider temporal perspectives when studying human nature, both in terms of general understanding and practical interventions to modify biased time perspectives (Zimbardo & Boyd, 2008). Zimbardo and Boyd (1999) empirically distinguished five dimensions which can be used to describe an individual time perspective profile: Past Positive, Past Negative, Present Fatalism, Present Hedonism and Future which are measured via Zimbardo Time Perspective Inventory (ZTPI). As the authors of the scale notice "refinement of the ZTPI was empirically driven, based on repeated factor analyses of the pool of statements thought to characterize different TPs. These items, collected from many different sources, reliably produced five distinct factors when factor analyzed. There was no a priori theoretical prediction of the number of characteristics of the factors that we would obtain" (Zimbardo & Boyd, 1999, p. 1273).

The Past Negative TP is based on a concentration on unpleasant events from the past, as well as on negative interpretation of all past events (Zimbardo & Boyd, 1999). People with high Past Negative often experience negative emotions and anxiety, and tend to fall into a depressed state. This perspective is positively associated with both neuroticism (average correlation 0.48; Kairys & Liniauskaite, 2015) and aggression (0.49) and negatively with self-esteem (−0.48; Zimbardo & Boyd, 1999). It also correlates negatively with conscientiousness (average correlation −0.19), extraversion (average correlation −0.24; Kairys & Liniauskaite, 2015) and satisfaction with life (0.40; Shipp, Edwards & Lambert, 2009; Zhang & Howell, 2011). A focus on Past Negative is associated with lower levels of emotional intelligence (−0.18; Stolarski et al., 2011) and lower educational achievements (Fieulaine, Apostolidis & Olivetto, 2006).

Past Positive refers to a positive perception of past events, sentimentality and acceptance of the past, as well as attachment to traditions and rituals. It correlates positively with self-esteem (0.28; Zimbardo & Boyd, 1999), life satisfaction (0.41; Zhang & Howell, 2011) extraversion (average correlation 0.18; Kairys & Liniauskaite, 2015) and emotional intelligence (0.26; Stolarski et al., 2011). Past Positive also shows an inverse association with anxiety (−0.25) and aggression (−0.16; Zimbardo & Boyd, 1999).

Present Hedonistic TP refers to a concentration on pleasure, obtaining instantaneous gratification of activities and little concern about the future consequences of one's actions. Hedonically oriented people tend to take risks, have low ego control (Zimbardo & Boyd, 1999) and have high impulsivity (MacKillop, Anderson, Castelda, Mattson & Donovick, 2006). However, hedonistic perception of time positively correlates with trait emotional intelligence (0.20; Stolarski et al., 2011), satisfaction with life (0.15; Zhang & Howell, 2011), optimism (Boniwell, Osin, Linley & Ivanchenko, 2010), positive mood (0.23; Stolarski, Matthews, Postek, Zimbardo & Bitner, 2014) and positive relationships with others (Sircova & Mitina, 2008).

Present Fatalistic orientation is based on resignation, hopelessness and a belief that life cannot be influenced—but that luck and fate make decisions (Zimbardo & Boyd, 1999). An elevated level of this perspective is reflected in a strong conviction that life is unpredictable and unstable; thus this attitude is combined with reluctance to planning (Baumann & Odum, 2012), which may result in lower academic achievements (Mello & Worell, 2006) and a lower level of education (Fieulaine et al., 2006). Fatalism correlates positively with neuroticism (average correlation 0.26; Kairys & Liniauskaite, 2015), depression (0.37), anxiety (0.38) and aggression (0.39; Zimbardo & Boyd, 1999), and is characterized by lack of internal control (MacKillop et al., 2006).

Future TP focuses on long-term goals, which are associated with planning as well as achievements and success in life. People whose life is dominated by this perspective are able to perform multiple tasks under time pressure, and they have developed advanced strategies for coping with stress (Zimbardo & Boyd, 1999). Moreover, Future is positively associated with conscientiousness (average correlation 0.60 Kairys & Liniauskaite, 2015), ability to delay gratification, internal control (Shipp et al., 2009), patience (Schnitker & Emmons, 2007) and trait emotional intelligence (0.20; Stolarski et al., 2011). Focusing on the future is connected to low risk, low impulsivity (MacKillop et al., 2006) and low aggression (−0.31; Zimbardo & Boyd, 1999).

Zimbardo and Boyd (2008) claimed that a specific combination of time dimensions might be more adaptive than others. This combination creates Balanced Time Perspective (BTP), defined as "the mental ability to switch effectively among TPs depending on task features, situational considerations and personal resources, rather than be biased toward a specific TP that is not adaptive to situations" (Zimbardo & Boyd, 1999, p. 1285). The difference between individual time perspective and the BTP profile has been recently operationalized by Stolarski et al. (2011) as Deviation from Balanced Time Perspective (DBTP). The closer to zero the DBTP value is, the more adaptive and more optimal the time perspective is (Stolarski et al., 2011). It has been shown that DBTP is beneficial for satisfaction with life (Zhang et al., 2013) or emotional intelligence (Stolarski et al., 2011).

1.2. Intelligence and non-cognitive traits

There has been a long tradition of linking intelligence with non-cognitive traits, especially with personality dimensions. Most of the studies in this area referred to Cattell's (1971) distinction between fluid intelligence (gf), representing information-processing and reasoning ability—both dependent on the efficient functioning of the central nervous system—and crystallized intelligence (gc), representing abilities to acquire, retain, organize and conceptualize information that is acquired through experience and education. In the case of personality, the Five Factor Model distinguishing neuroticism, extraversion, openness to experience, agreeableness and conscientiousness (Costa & McCrae, 1992) dominates in the empirical investigations (DeYoung, 2011). However, recent important investigations were based on the Big Five scales measured via the International Personality Item Pool (IPIP; Goldberg et al., 2006) and the most interesting findings referred to the factor labeled openness/intellect (see DeYoung, 2011).

General conclusions drawn from the meta-analyses and studies on large samples (Ackerman & Heggestad, 1997; Austin et al., 2002) are that intelligence correlates positively with personality traits that might be categorized as adaptive and negatively with maladaptive traits (Austin et al., 2002). However, a deeper analysis of the possible intelligence-personality associations distinguishes various theoretical perspectives (von Stumm, Chamorro-Premuzic & Ackerman, 2011). According to one, personality may influence intelligence at the measurement level. For instance, it has been shown that neuroticism is negatively correlated with intelligence (Ackerman & Heggestad, 1997), and IQ test anxiety may be an explanation for this result. Moreover, Zeidner and Matthews (2000) noted that the relationship between extraversion and intelligence may be mediated by the nature of an intelligence test. Because of the differences in cortical arousal between extraverts and introverts (Eysenck, 1994), the dimension of extraversion may be associated with certain cognitive styles and intelligence profiles but not necessarily with actual ability (Zeidner & Matthews, 2000). Another perspective on the intelligence-personality link assumes a developmental dependence between the two constructs, such that personality traits influence the degree to which people apply or invest their intellectual abilities. This approach may explain the relatively moderate (0.30 to 0.40) correlation between openness/intellect to experience and cognitive ability (DeYoung, 2011). It has been suggested that openness/intellect correlates more specifically with gc

rather than gf, because high openness may motivate a person to engage in intellectual pursuits, which in turn increases gc (Moutafi, Furnham, & Paltiel, 2005; Zeidner & Matthews, 2000). Finally, some recent investigations showed a negative association between conscientiousness and intelligence (Moutafi et al., 2004, 2005), and the compensation mechanism has been proposed as an explanation for this result (von Stumm et al., 2011). In particular, it is possible that less intelligent people may compensate for their lower intellectual capacity by developing a high level of conscientiousness.

A meta-analysis of studies to date that reported correlations between TPs and the Big Five traits showed that a notable part of variance is shared by these two areas. In particular, relationships between Past Negative and neuroticism, Present Hedonistic and extraversion, and Future and Conscientiousness are worth noting (Kairys & Liniauskaite, 2015). However, in spite of TP's moderate convergence with personality, a considerable number of studies have demonstrated the incremental validity of TPs over and above traditional (the Big Five traits) measures of personality (Daugherty and Brase (2010) for health; Ely and Mercurio (2011) for autobiographical memory; Zhang and Howell (2011) for well-being). Moreover, personality is a broad construct (not reducible to the Big Five), describing the coherency and consistency in an individual's pattern of affects, cognitions, desires and behaviors (Revelle, 2007). Zimbardo and Boyd (1999, 2008) emphasized a complex character of time perspective: although particular TPs may partly emerge from some personality predispositions (e.g. neuroticism, conscientiousness), they are largely products of environmental and cultural factors. Thus, research linking TP with cognitive ability may provide some novel insights into IQ's nomological network.

1.3. Factors mediating the association between intelligence and non-cognitive traits

As mentioned above, non-cognitive traits might influence the measurement of intelligence. This could be due to emotional response to the process of solving a demanding intellectual test exhibited by individuals with particular personality traits—for example, high neuroticism. The mediating role of test stress in the relationship between personality and cognitive performance has been recently explored by Zajenkowski and Zajenkowska (2015), who sought psychological states that accompanied individuals with high levels of particular personality traits while they were solving an intelligence test. A useful tool in these attempts appeared to be the concept developed by Matthews et al. (2002) who proposed a multi-dimensional model of subjective stress state related to cognitive performance. They identified three broad factors: task engagement (integrates state constructs that relate to task interest and focus: energetic arousal, motivation and concentration), distress (integrates unpleasant mood and tension with lack of confidence and perceived control) and worry (a cognitive factor primarily composed of self-focused attention, low self-esteem and cognitive interference). It has been shown that stress states may explain the associations between some personality traits (e.g., trait anger) and the score on an IQ test (Zajenkowski & Zajenkowska, 2015).

Studies linking personality with intelligence suggest that the beliefs about cognitive ability might be another important factor associated with both discussed constructs. Relatively much work has been devoted to self-assessed intelligence (SAI; Ackerman & Wolman, 2007; Chamorro-Premuzic & Furnham, 2006a; Furnham, 2001). Correlations between SAI and psychometrically measured intelligence usually range from 0.20 to 0.50 (Chamorro-Premuzic & Furnham, 2006b; Ackerman & Wolman, 2007). Moreover, SAI has been linked to high extraversion and openness, and low neuroticism and agreeableness (Chamorro-Premuzic & Furnham, 2006b). These findings led some researchers to the suggestion that SAI might be considered a mediating variable between personality and intelligence (Chamorro-Premuzic & Furnham, 2004). Chamorro-Premuzic and Furnham (2004) notice, however, that one important distinction should be made when considering the link between personality, intelligence and SAI. Specifically, intelligence may be studied from two perspectives: as IQ test performance, or as 'actual' ability. Thus, personality traits can modify the results of IQ tests, or determine the development of intellectual ability. Such personality traits as neuroticism and extraversion typically influence one's estimations of their own abilities (e.g., underestimation of neurotics), which in turn affects test performance (Chamorro-Premuzic & Furnham, 2006b). However, with regard to other traits, e.g. openness, the relationship to SAI is likely to be more complex. Because there is a conceptual and empirical overlap between SAI and openness, Chamorro-Premuzic and Furnham (2004) have proposed that the latter, like SAI, might be interpreted as a self-report measure of typical intelligence, particularly of gc.

1.4. Current studies

Considering the previous studies on intelligence and non-cognitive traits, one may describe the potential associations between cognitive ability and TP from various perspectives. The simplest and most general expectation would suggest that intelligence should correlate positively with adaptive and negatively with maladaptive TP dimensions, as it is does with personality traits (Austin et al., 2002). According to many empirical findings, the former TPs would comprise Past Positive and Future, while the latter group would include Past Negative and Present Fatalism (Stolarski et al., 2015; Zimbardo & Boyd, 1999). According to the adaptive perspective, it would be difficult to predict the direction of the relationship between Present Hedonistic TP and cognitive ability since hedonism has been shown to correlate with many "negative" outcomes, such as risky driving (Zimbardo, Keough & Boyd, 1997) and proneness to mania (Gruber, Cunningham, Kirkland & Hay, 2012), as well as "positive," including elevated well-being (Zhang & Howell, 2011) and positive mood (Stolarski et al., 2014). These general expectations might be further considered in a more detailed way by showing particular mechanisms of the relationships between each TP and intelligence.

Taking another perspective—associations at measurement or developmental level—one may predict more specific relationships between intelligence and TP. In particular, Past Negative and Present Fatalism are theoretically and empirically related with negative emotionality. Both correlate highly with neuroticism (Kairys & Liniauskaite, 2015), trait anxiety, depression (Zimbardo & Boyd, 1999) and negative mood (Stolarski et al., 2014). Therefore, one may expect a negative association between the aforementioned TPs and intelligence (von Stumm et al., 2011). Moreover, a possible mechanism explaining this relationship might be the negative influence of Past Negative and Present Fatalism on intelligence at the measurement level. Specifically, individuals with high levels of these dimensions might experience negative states, such as a high level of stress, while taking a demanding cognitive test. Additionally, both Past Negative and Present Fatalistic TPs exhibit lower self-esteem (Zimbardo & Boyd, 1999), which has been linked to subjectively assessed intelligence (Dufner et al., 2012). Thus, one may also expect that these time orientations will be associated with low levels of self-reported intelligence, which in turn will lead to lower scores on ability tests.

Past Positive has been systematically linked to high positive and low negative emotionality (Stolarski et al., 2014). Although there is no clear evidence how positive affect correlates with intelligence tests, many studies show that low stress is beneficial for working memory (Matthews & Campbell, 2010) and executive control (Matthews & Zeidner, 2012), constructs crucial for fluid intelligence (Chuderski, Taraday, Necka & Smolen, 2012). Therefore, one may expect that Past Positive will be associated with low stress in test-taking situations and possibly with better performance on the IQ test.

It is likely that two TP dimensions might be associated with intelligence at the developmental level. Specifically, Future TP and Present Hedonism have been defined as two opposite attitudes toward future consequences (Zimbardo & Boyd, 1999). Present Hedonistic TP relates

to a pleasure-oriented attitude toward life, with little concern for future consequences of one's actions, while Future relates to high conscientiousness and consideration of future consequences. Moreover, Zimbardo and Boyd (2008) describe gratification delay as the essence of Future TP; deficiencies in the ability to delay gratification lead to a distinct Present-Hedonistic TP. This theoretical assumption is congruent with classic studies investigating the role of gratification-delay processes in the development of fundamental future-oriented behaviors and attitudes (Mischel, Shoda & Rodriguez, 1989). These attitudes toward future consequences and gratification delay also might have an impact on intellectual development. In particular, it has been shown that, on a behavioral level, Future-oriented individuals spend more hours studying per week and have better grades, while hedonism is associated with poorer academic outcomes (Zimbardo & Boyd, 1999). Additionally, delay discounting, the tendency to prefer smaller, sooner rewards to larger, later ones, proved to correlate negatively with intelligence and educational achievements (Shamosh & Gray, 2008). The individual discounting rate might be treated as an indicator of gratification delay. All these findings and considerations lead to a suggestion that individuals with high Future TP are more likely to develop their cognitive potential through hard work while for hedonistic individuals potential rewards associated with intellectual development might be too distant to motivate them. Therefore, we expect a positive association between Future orientation and crystallized intelligence, and an inverse relationship between Present Hedonism and crystallized ability.

As both Balanced TP and intelligence may be treated as indicators of adaptation, it seems natural to expect a positive association between these constructs. An in-depth look into the nature of these two constructs makes this expectation even more justifiable: BTP is even defined not as a trait (like other TP dimensions), but as an ability (Zimbardo & Boyd, 1999). TP may be understood as a set of stable individual differences, but these differences reflect biases in a cognitive-emotional process of temporal framing of experience. Therefore, a cognitive aspect remains an inevitable feature of BTP. Conceptualized as an ability to "flexibly interlock" between particular time horizons, BTP seems to be a consequence of a capability to exercise control over this process of cognitive framing, which should facilitate effective switching between particular TPs. Theoretically then, BTP may be partly a result of an effective attentional control, which in turn remains a core feature of fluid intelligence (Chuderski et al., 2012). Thus, it seems probable that intelligence may provide a basis for the development of Balanced TP. On the other hand, BTP has been considered an index of general emotional adaptation (Stolarski et al., 2011; Stolarski et al., 2014); as a result, one may expect its impact on IQ test scores via adaptive regulation of task-related affective states.

Below, we report two studies verifying aforementioned hypotheses. The aim of study 1 was to examine simple associations between various aspects of intelligence (e.g., fluid, verbal, general) and TP. Moreover, SAI as a mediating variable has been assessed. Study 2 explored the potential mediating role of test-related stress in the relationship between intelligence and TP.

2. Study 1

2.1. Method

2.1.1. Participants

A total of 238 subjects took part in the study (120 females and 118 males). Their mean age was 22.40 (SD = 2.64) with range 18–31. The sample was composed of undergraduate students from various universities in Warsaw, Poland. Volunteer participants were recruited via publicly accessible social networking websites. Each participant gave informed consent and was offered a small gift (e.g. a cup) for taking part in the study. The data were collected in two waves (n = 78 and n = 160). In the second wave, one additional measure of subjectively assessed intelligence has been included. The two subsamples did not differ in any of the measured variables.

2.1.2. Measures

Time perspective was assessed with the Zimbardo Time Perspective Inventory (Zimbardo & Boyd, 1999). It has five scales: Past Negative, Present Hedonistic, Future, Past Positive and Present Fatalistic. Respondents rate their degree of endorsement of each statement on a five-point Likert scale. Additionally, we calculated the deviation from a balanced time perspective (DBTP; Stolarski, Bitner & Zimbardo, 2011), a continuous indicator describing the fit between individuals' score on TPs and the optimal TP profile. An optimal score for each TP scale has been proposed by Zimbardo and Boyd (2008), basing on their huge collective cross-cultural database. In particular, Zimbardo and Boyd defined a 'high' score on past positive as 1.5 SD above mean, a 'moderately high' score on present hedonism and future as 1 SD above mean, and 'low' on past negative and present fatalism as 1.5 SD below mean. DBTP is the root of sum of squared deviations of individual's scores from the optimal score on each scale (Stolarski et al., 2011). Thus, the lower the DBTP score, the more balanced TP. Zhang, Howell and Stolarski (2013) have shown that this indicator of BTP has higher predictive validity than other existing BTP's indicators: a cut-off point approach and a cluster analysis.

Fluid intelligence was measured with Raven's Advanced Progressive Matrices Test (APM; Raven, Court & Raven, 1983).

Verbal intelligence was assessed with a Polish test of verbal comprehension designed to measure crystallized abilities (Matczak, Jaworowska & Martowska, 2013). In this test, participants are asked to find a synonym for a target word among four different words. There are 30 items of increasing difficulty, which an individual has to solve within 15 min. The test has high split-half reliability and correlates positively with other IQ tests (e.g., WAIS-R and Raven).

Subjectively assessed intelligence (SAI) was assessed by having participants first read the general characteristic of intelligence taken from a public statement known as "Mainstream Science on Intelligence" issued by a group of 52 academic researchers in fields associated with intelligence (Gottfredson, 1997b). Next, participants assessed their own intelligence on a 1–25 point rating scale (see Appendix). Five groups of five columns were labeled as very low, low, average, high or very high, respectively. Participants' SAI was indexed with the marked column counting from the first to the left; thus the score ranged from 1 to 25 (see Zajenkowski & Czarna, 2015). SAI was assessed for only part of the sample: 160 participants.

2.2. Results

In Table 1 we present correlations between time orientation, assessed with the ZTPI, and fluid and verbal intelligence. Moreover, we extracted a first principal component from the two intelligence measures (with the amount of shared variance of 27%) to calculate general scores for all participants.

The Past Negative and Present Fatalistic perspectives negatively correlated with fluid, verbal and general intelligence. Greater Present Hedonistic orientation was associated with lower verbal ability, but did not significantly correlated with fluid intelligence. Thus, we decided to test the difference between the correlations (Williams, 1959) of Present Hedonism with the two intelligence tests, and found that they differed significantly ($t = 1.97$; $p < 0.05$). Our results indicated also that higher Future perspective was positively correlated with higher verbal intelligence, and that there was no significant association with fluid intelligence; however, these two correlations did not differ from one another ($t = 1.92$; $p > 0.05$). Finally, the Deviation from Balanced Time Perspective (DBTP) indicator was negatively correlated with fluid intelligence, meaning people who have more balanced time perspective scored higher on Raven's test.

Table 1
Correlations between time perspectives and intelligence measures (n = 238).

	PN	PP	PH	PF	F	DBTP	Raven	Verbal	I-PC	SAI	M (SD)	α
PN		−0.08	0.19**	0.38**	−0.19**	0.65**	−0.15*	−0.14*	−0.18**	−0.13	2.97 (0.71)	0.77
PP			0.29**	0.17**	−0.03	−0.55**	0.05	−0.12	−0.05	−0.07	3.40 (0.61)	0.67
PH				0.30**	−0.29**	−0.12	−0.12	−0.27**	−0.24**	−0.13	3.31 (0.64)	0.81
PF					−0.37**	0.47**	−0.21**	−0.27**	−0.30**	−0.31**	2.38 (0.61)	0.73
F						−0.33**	−0.01	0.14*	0.08	−0.01	3.49 (0.59)	0.80
DBTP							−0.15*	−0.04	−0.12	−0.13	2.30 (0.65)	–
Raven								0.27**	0.80**	0.41**	24.04 (6.09)	0.88
Verbal									0.80**	0.21**	14.57 (9.56)	0.95
I- PC										0.42**		–

Note. PN = Past Negative; PP = Past Positive; PH = Present Hedonistic; PF = Present Fatalistic; F = Future; DBTP = Deviation from Balanced Time Perspective; Verbal = verbal intelligence; I-PC = principal component extracted from two measures of intelligence; SAI = subjectively assessed intelligence. SAI was administered only to part of the sample (n = 160).
* $p < 0.05$.
** $p < 0.01$.

Furthermore, the results revealed that SAI correlated negatively with Present Fatalism and positively with both ability measures used in study and the intelligence principal component. Similarly to previous research on personality and intelligence (e.g. Chamorro-Premuzic & Furnham, 2004), we decided to examine whether SAI mediates the relationship between fatalism and cognitive ability. It should be acknowledged, that SAI was administered to only part of the sample (n = 160), thus in the present analysis the correlations between Present Fatalism and intelligence slightly differed from these reported in Table 1 and equaled −0.37, $p < 0.01$ for principal component of intelligence, −0.21, $p < 0.05$ for Raven, and −0.33, $p < 0.01$ for verbal ability.

We used the PROCESS macro for SPSS developed by Hayes (2015) which tests for indirect effects by calculating (bootstrapping) confidence intervals for indirect (mediated) effects. The mediation analysis (n = 160; see Fig. 1) revealed that the total effect between Present Fatalism and intelligence principal component ($\beta = -0.37$, $p < 0.001$) was reduced upon the inclusion of the mediator, SAI ($\beta = -0.26$, $p < 0.001$), indirect effect = −0.09, $p < 0.05$ (based on the bias-corrected 95% confidence interval not spanning zero: lower = −0.15, upper = −0.04). Thus, SAI partially mediated the relationship between Present Fatalism and intelligence. Subsequently, we have calculated the mediation effect size according to the formula ab / (ab + c') recommended by Iacobucci, Saldanha, and Xiaoyan Deng (2007) which describes the ratio of the indirect effect to the total effect. In the present analysis the effect size was 0.29, 95% CI = [0.13, 0.53], meaning that SAI mediates approximately 29% of the total effect of Present Fatalism on intelligence. It should be acknowledged, however, that this interpretation should be taken with caution. Preacher and Kelley (2011) have recently discussed several limitations of the effect size we used here. For instance, they indicated that the index is not literally a proportion and not comparable across different studies. Although its weak points, it has also advantages, such as the possibility to calculate confidence interval and being independent of the sample size (Preacher & Kelley, 2011; Wen & Fan, 2015).

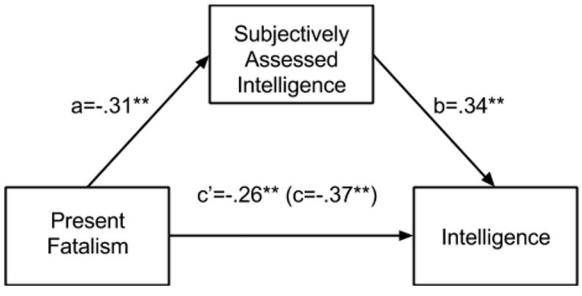

Fig. 1. Relationships between Present Fatalism, Subjectively Assessed Intelligence and intelligence principal component score (n = 160). The paths a and b are direct, c is the total effect from Present Fatalism to Raven and c' is the direct path from Present Fatalism to Raven, controlling for SAI. *$p < 0.05$; **$p < 0.01$.

3. Study 2

3.1. Method

3.1.1. Participants

A total of 306 subjects took part in the study (142 females and 164 males). Their mean age was 23.10 (SD = 3.85) with range 18–31. The sample was composed of undergraduate students from various universities in Warsaw, Poland. Volunteer participants were recruited via publicly accessible social networking websites. Each participant gave informed consent and was offered a small gift (e.g. a cup) for taking part in the study.

3.1.2. Measures

Time perspective and fluid intelligence were assessed with the same tools as in study 1.

Stress states related to cognitive performance were measured with the Dundee Stress State Questionnaire (DSSQ; Matthews et al., 2002) in the short version (see Matthews & Zeidner, 2012), translated into Polish (Zajenkowski & Zajenkowska, 2015). DSSQ measures three factors: task engagement, distress and worry. On the instrument, there are 24 items with 5-point response scales. The internal consistency of the Polish version is high (task engagement $\alpha = 0.80$; distress $\alpha = 0.76$; worry $\alpha = 0.84$). DSSQ was administered twice: just before and immediately after Raven's test.

3.2. Results

In Table 2 we present the relationships between TPs, fluid intelligence and three stress states before and after the completion of the intelligence test. Two perspectives exhibited higher stress while taking the test: Past Negative was positively correlated with the pre- and post-levels of distress and worry; high Present Fatalistic individuals showed lower post-task engagement and stronger post-task worry. Additionally, participants more focused on Past Positive perspective exhibited lower distress after completing the task. Individuals scoring high on Present Hedonistic had a tendency to worry before the task. Future-oriented people tended to score higher on post-task engagement. The DBTP was negatively correlated with engagement (pre- and post-task), and positively correlated with distress (both measurements) as well as with worry (only post-task). These results indicate that greater distance from balanced TP leads to higher stress during cognitive testing. Finally, better performance on the Raven test was significantly associated with high post-task engagement, low post-distress and low post-worry.

It is believed that the pre-task DSSQ score might be related to a typical state experienced by individuals, while the post-task score is most representative of the state during task performance (Matthews & Zeidner, 2012). Therefore, we decided to test whether TPs predict the second measurement of stress states, controlling for the pre-task

Table 2
Correlations between time perspectives, stress states and fluid intelligence (n = 306).

	Raven	TE1	DIS1	WOR1	TE2	DIS2	WOR2	M (SD)	α
PN	−0.14*	−0.11	0.32**	0.24**	−0.10	0.28**	0.33**	2.91 (0.71)	0.79
PP	−0.01	0.09	−0.07	0.14*	0.05	−0.13*	0.02	3.43 (0.62)	0.65
PH	−0.03	−0.04	0.10	0.25**	−0.11	−0.01	0.08	3.37 (0.64)	0.82
PF	−0.15**	−0.18**	0.19**	0.13*	−0.32**	0.04	0.16**	2.44 (0.65)	0.75
F	−0.07	0.24**	−0.04	−0.04	0.17**	−0.02	0.05	3.42 (0.66)	0.84
DBTP	−0.13*	−0.23**	0.24**	0.03	−0.25**	0.22**	0.12*	2.32 (0.67)	–
Raven		−0.01	−0.08	−0.11	0.28**	−0.27**	−0.27**	23.90 (6.05)	0.91
TE1			−0.39**	−0.12*	0.52**	−0.16**	−0.19**	20.67 (4.54)	0.69
DIS1				0.32**	−0.32**	0.52**	0.32**	11.03 (4.80)	0.73
WOR1					−0.13*	0.13*	0.51**	15.38 (6.29)	0.81
TE2						−0.35**	−0.35**	21.46 (5.23)	0.77
DIS2							0.34**	15.30 (5.56)	0.81
WOR2								10.46 (6.33)	0.85

Note. PN = Past Negative; PP = Past Positive; PH = Present Hedonistic; PF = Present Fatalistic; F = Future; TE1 = pre-Task Engagement; TE2 = post-Task Engagement; DIS1 = pre-Distress; DIS2 = post-Distress; WOR1 = pre-Worry; WOR2 = post-Worry; DBTP = Deviation from Balanced Time Perspective.
* $p < 0.05$.
** $p < 0.01$.

score. Table 3 shows the results of a series of regression analyses. In each case, we introduced the first measurement of a given stress state together with one TP dimension. The results revealed that Past Negative and Present Fatalistic were associated with greater stress after completing Raven's test even after controlling for the first stress assessment. Specifically, Past Negative correlated with higher worry and distress, while Present Fatalistic was associated with lower task engagement. Moreover, people with more balanced TP experienced higher engagement and lower worry after the task. These results suggest that the stress accompanying individuals with high Past Negative, high Present Fatalistic and poorly balanced TPs was partially a response to the test performance.

Subsequently, we decided to test whether post-task stress states associated with Past Negative, Present Fatalistic and Deviation from Balanced TPs might be considered as mediators between these time orientations and the Raven's score. The PROCESS macro by Hayes (2015) was used as in study 1.

The first analysis (see Fig. 2) revealed that stress states fully mediated the link between Present Fatalism and Raven's test. Specifically, the relationship between Present Fatalistic TP and intelligence ($\beta = -0.15$, $p = 0.009$) was reduced upon the inclusion of the mediators, task engagement and worry; the indirect effect was −0.09, $p < 0.05$, 95% CI = [−0.15, −0.04]. Similarly to study 1, we calculated the mediation effect size. In this case the mediation effect size (the ratio of the indirect effect to the total effect) was 0.61, 95% CI = [0.24, 2.40].

Subsequent analysis indicated that stress states fully mediated the relationship between Past Negative TP and Raven's test: the association ($\beta = -0.14$, $p = 0.012$) was significantly reduced upon the inclusion of distress and worry (mediators), and the indirect effect was 0.12, $p < 0.05$, 95% CI = [−0.18 to −0.07]. The mediation effect size (the ratio of the indirect effect to the total effect) was 0.85, 95% CI = [0.32, 5.05] (Fig. 3).

The last analysis revealed that stress states fully mediated the relationship between Deviation from Balanced TP and Raven's test (see Fig. 4). Specifically, the association ($\beta = -0.13$, $p = 0.031$) was significantly reduced upon the inclusion of task engagement, distress and worry (mediators), and the indirect effect was −0.10, $p < 0.05$, 95% CI = [−0.17 to −0.04]. The mediation effect size (the ratio of the indirect effect to the total effect) was 0.78, 95% CI = [0.32, 5.05].

Table 3
Results of regression analyses (betas) with pre-task stress states and time perspectives as predictors and post-task stress scores as dependent variables.

	TE2	Distress2	Worry2
TE1/Distress1/Worry1	0.54**	0.48**	0.45**
Past Negative	−0.02	0.12*	0.22**
TE1/Distress1/Worry1	0.54**	0.51**	0.51**
Past Positive	−0.01	−0.09	−0.06
TE1/Distress1/Worry1	0.54**	0.53**	0.51**
Present Hedonistic	−0.09	−0.07	−0.05
TE1/Distress1/Worry1	0.50**	0.53**	0.49**
Present Fatalistic	−0.23**	−0.06	0.09
TE1/Distress1/Worry1	0.53**	0.52**	0.50
Future	0.04	0.01	0.07
TE1/Distress1/Worry1	0.51**	0.50**	0.49
Deviation from Balanced Time Perspective	−0.12*	0.09	10*

Note. TE1 = pre-Task Engagement; TE2 = post-Task Engagement; DIS1 = pre-Distress; DIS2 = post-Distress; WOR1 = pre-Worry; WOR2 = post-Worry.
* $p < 0.05$.
** $p < 0.01$.

4. Discussion

The aim of the present studies was to examine the association between five TPs and intelligence, as well as to identify potential mediators of this relationship. We found that four TPs and an indicator of balance correlated significantly with some aspects of cognitive ability. Present Fatalistic TP had the strongest and negative relationship with all aspects of intelligence. The analyses revealed that individuals with fatalistic orientation have a tendency to assess their intelligence as low and to experience increased stress states while taking an intelligence test. Interestingly, the stress experienced by fatalists was mainly associated with task engagement and worry, not with distress. This indicates for the role of motivational and cognitive aspects of stress, rather than emotional. The obtained results seem to be in line with the definition of Present Fatalism, which is described mainly in terms of beliefs and motivation. Zimbardo and Boyd (1999) define this TP as an orientation of hopelessness and helplessness, the belief of little control over one's life and its unpredictability and that the present must be borne

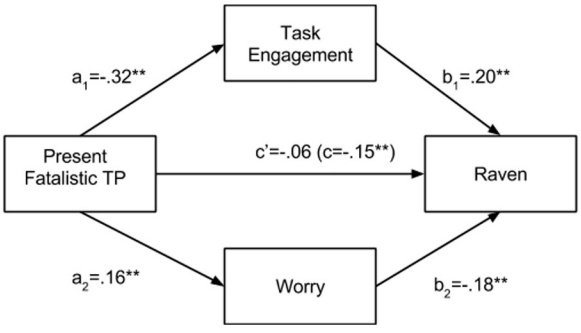

Fig. 2. Relationships between Present Fatalism, Task Engagement, Worry and Raven's test. The paths with a's and b's are direct, c is the total effect from Present Fatalism to Raven and c' is the direct path from Present Fatalism to Raven, controlling for Task Engagement and Worry. **p < 0.01.

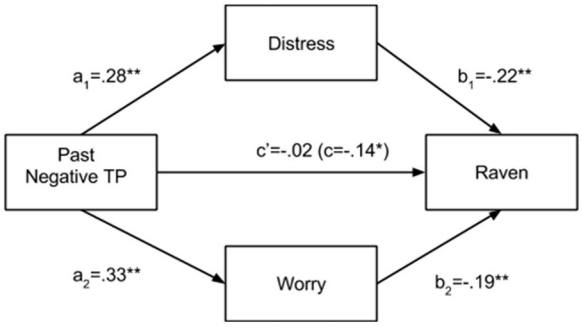

Fig. 3. Relationships between Past Negative, Distress, Worry and Raven's test. The paths with a's and b's are direct, c is the total effect from Past Negative to Raven and c' is the direct path from Past Negative to Raven, controlling for Distress and Worry. *p < 0.05; **p < 0.01.

with resignation because humans are at the whimsical mercy of "fate"; luck is as good a factor in success as preparation and hard work for those with Present Fatalistic orientation. It is possible that fatalists hold a negative view about their cognitive ability and faced with a demanding cognitive task, such as an intelligence test, they experience lack of motivation, simply because they do not believe that they can effectively cope with the encountered difficulties. This explanation is also congruent with previous research on SAI. For instance, Chamorro-Premuzic and Furnham (2006a) argue that SAI may determine the level of effort an individual is prepared to invest: low levels of SAI may have negative effects on one's confidence and thus lead to intellectual avoidance.

Interestingly, the belief that one cannot influence one's abilities is conceptually close to the construct of implicit theories of intelligence (Dweck, 1999; Hong, Chiu & Dweck, 1995). Dweck (1999) discerned different outlooks based on whether one believes that human attributes are fixed or that they are malleable. People with a fixed mindset view intelligence as an inborn, uncontrollable trait, while a malleable mindset is a belief that intelligence is a changeable attribute that can be developed through effort. An individual's implicit theory about human attributes structure the way he or she understands and reacts to human actions and outcomes. Empirical studies have shown that implicit theories about intelligence are associated with adaptive or maladaptive cognitive performance, affect and behavior in difficult achievement situations (Dweck, 1999). The belief that intelligence is a fixed trait is associated with helpless reactions to achievement setbacks, whereas the belief that intelligence is malleable is connected with mastering behavior in the face of difficulties. Dweck (1999) argues that the

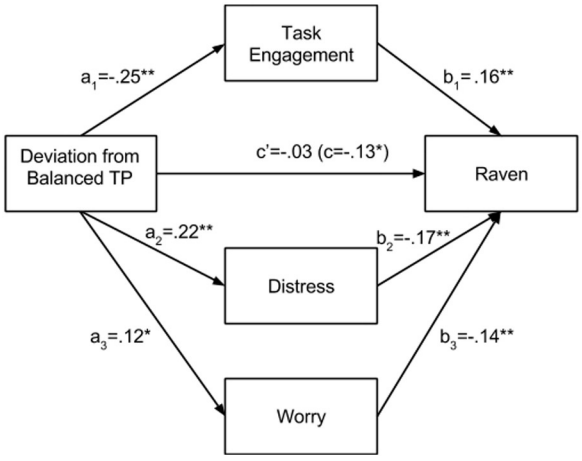

Fig. 4. Relationships between Deviation from Balanced Time Perspective (DBTP), Task Engagement, Distress, Worry and Raven's test. The a's and b's are direct paths, c is the total effect from DBTP to Raven and c' is the direct path from DBTP to Raven, controlling for stress states. *p < 0.05, **p < 0.01.

former option entails the tendency to seek the reasons for achievement setbacks in one's own ability, while people taking the latter perspective tend to seek those reasons in a lack of effort or adequate strategy. One may wonder whether subjects with high Present Fatalistic TP also believe that their intellectual abilities are fixed, and because of that they give up when encountering difficulties. In the present studies, demanding intellectual tests were used, so it is possible that fatalists didn't put much effort into challenging a hard task, thinking that they were not able to manage.

Individuals with high Past Negative TP obtained low scores on both intelligence measures. Moreover, two stress states fully accounted for the relationship between Past Negative and Raven's test: worry and distress. The latter result suggests that this TP, unlike fatalism, is related to emotional aspects of stress in the context of cognitive performance. This is consistent with the definition of Past Negative as well as empirical findings showing that the negative view of the past is linked with many aspects of negative emotionality, including anxiety, depression, aggression and tension (Zimbardo & Boyd, 1999). Stolarski et al. (2014) showed also that individuals with high Past Negative expect negative moods. The authors investigated how TPs influence recalled and anticipated affect, by measuring mood twice in a four-week period. They asked participants to assess their current state as well as to anticipate how they will feel in a few weeks (first measurement) and how they had felt during previous session (second measurement). It has been found that Past Negative TP was correlated with a bad mood; interestingly, however, it was more strongly related to bias in anticipation of mood than to bias in recall. Stolarski et al. (2014) suggested that accessing negative beliefs about the past may support a self-schema that biases both immediate experience and future projections. It is then possible that this generalized attitude is also relevant for cognitive test performance. Negative past experiences might be projected on the expectations regarding the test situation, and higher levels of distress and worry, which mediated the association between Past Negative and Raven's scores, may simply reflect a fear of failure in this particular performance.

Future TP correlated positively and significantly with verbal intelligence. This result is consistent with our expectation, and potentially distinguishes Future from its personality correlate—conscientiousness. The latter has been recently found to correlate negatively with intelligence (Moutafi et al., 2004, 2005; Zajenkowski & Stolarski, 2015). For instance, Moutafi et al. (2005) reported an inverse association between fluid ability and negative but non-significant correlation with crystallized intelligence. The authors suggested a compensation hypothesis, according to which less intelligent individuals develop higher levels of conscientiousness. People with high ability do not need to be very conscientious as they can rely solely on their intellect to accomplish most tasks. Moutafi et al. (2004) suggested that direction of causality must be that intelligence affects the development of conscientiousness, because the former is less susceptible to influences of the environment and not basically dependent on our experience (Brody, 1992). Further, highly conscientious individuals probably increase gc by hard work, persistence and dutifulness develop to compensate for quick-wittedness. In the present study we found that Future TP is positively associated with the verbal IQ test; additionally, Future did not correlate significantly with fluid ability measured by Raven's test. However, it has to be acknowledged that there was no significant difference between these two (Future-fluid and Future-verbal intelligence) correlations. Nevertheless, our results may suggest that Future-oriented people effectively invest their intellectual potential, which probably results in an increased level of gc. Interestingly, the proposed explanation would locate Future among so-called investment traits, which refer to personality characteristics determining the degree to which people apply or invest their intellectual abilities (von Stumm et al., 2011). The investment traits include such dimensions as openness, typical intellectual engagement and need for cognition, all of which might be described as a desire to engage in intellectual problems (von Stumm et al., 2011). However, in case

of Future, there might be a different motivation for the ability investment. Individuals with high Future are characterized as striving for future goals which, when achieved, are rewarding. It is possible that in case of this TP dimension, intellectual development might be instrumental—that is, it serves as a tool to achieve demanding goals. For instance, studying for Future-oriented students may be necessary to obtain better grades, which in turn might be helpful for their career.

In the case of Present Hedonism we found no significant association with gf, and a moderate negative correlation with gc. Moreover, these two correlations differed significantly from one another. The results confirmed our expectations and are consistent with the data presented by Zimbardo and Boyd (1999), who showed that hedonists spend less time studying. It seems probable that the obtained effect results from a generalized lower motivation to sacrifice their time and energy in arduous process of transforming their intellectual potential into crystallized abilities. This explanation is strengthened by the fact that hedonists performed poorer only on the gc test, whereas their fluid mental capacity seems to be at a similar level to their low-hedonic counterparts'.

Balanced TP proved related to fluid intelligence tests and all stress states. This led us to analyze dynamics of this association in a mediation model. Less-balanced individuals experienced higher distress and worry, and lower task engagement, which resulted in worse IQ-test performance. These results seem to be in line with the affective regulation supposition, underlying the regulative role of BTP in emotional functioning: balanced individuals may achieve higher scores on IQ tests thanks to their elevated ability to manage their own emotions (Stolarski et al., 2011) or a generally more adaptive baseline mood profile (Stolarski et al., 2014). The regression analyses performed with controlled baseline stress states provides an argument for the former mechanism; however, the positive baseline attitude may be advantageous right from the beginning of test solving. Perhaps the effective emotional self-regulation related to BTP may reflect some more general metacognitive abilities, which are known to be critical for intelligence-test performance (Hertzog & Robinson, 2005).

The current studies have revealed that TPs are associated with various aspects of cognitive ability. Although we attempted to analyze potential mediators of these relations, such as emotional experiences or cognitive attitude, further investigations are necessary to uncover other specific mechanisms of the TP-intelligence link, such as associations of both constructs with simple cognitive processes. Future studies could also broaden the present methodology, applying not only self-reported dispositions (TP) but also tasks, which have been used in research on mental time travel (Suddendorf & Corballis, 2007). This capacity to go back in time but also to foresee, plan and shape virtually any specific future event is believed to be specifically human and based on a particularly efficient memory system, which characterizes our species. Little is known about individual differences in the ability to mentally travel into the past and future, though such an ability undoubtedly requires a large amount of cognitive resources. Finally, one important limitation of the present study should be noted here. As we mentioned above, individual differences in TPs are related to personality traits. In the present study we did not control for personality, thus it was not possible to determine whether the obtained results (e.g., the effects obtained for Present Fatalistic and Past Negative) were not due to their covariance with individual differences in personality (e.g., neuroticism which is related to both these TPs; see Kairys & Liniauskaite, 2015). It would be then highly desirable to test for incremental validity of TPs over and above personality, as it was already done in other studies on TP (e.g., Zhang & Howell, 2011; Daugherty & Brase, 2010).

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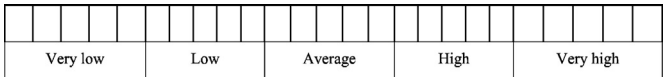
Appendix 1. The measure of subjectively assessed intelligence (SAI) used in study 1

Instruction. People differ with respect to their intelligence and can have a low, average or high level. Using the following scale, please indicate where you can be placed comparing to other people. Please mark an X in the appropriate box corresponding to your level of intelligence.



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