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The association between personality and aggressive driving: A meta-analysis

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The aim of the present paper was to synthesize previous results on the relationship between personality (from the perspective of the Big Five Model and Alternative Five model) and aggressive driving. Secondly, we aimed at identifying the model of personality with the highest level of association to aggressive driving. The statistical analyses were conducted exclusively for those dimensions of personality that overlap (i.e., Neuroticism vs. Neuroticism-Anxiety, Extraversion vs. Sociability, Agreeableness vs. Aggression - Hostility). We searched for empirical studies with (1) cross-sectional design, (2) all the data needed for the meta-analytical computations, and (3) written in English. Database searches revealed a sample of 78 articles out of which 16 were eligible. The total sample of participants was of 6,721. Using a random effects framework, regarding the Big Five Model, we found a weak effect size for the relationship between Neuroticism and aggressive driving ($r = .26$, $p < .001$), a very weak relationship between Extraversion and aggressive driving ($r = .07$, $p = .03$), and a weak effect size for Agreeableness and aggressive driving ($r = -.26$, $p < .001$). Regarding the Alternative Five model, we identified a weak effect size for Neuroticism – Anxiety ($r = .21$, $p = .05$), marginally significant and weak effect for Sociability ($r = .21$, $p = .06$), and a moderate effect size for Aggression – Hostility and aggressive driving ($r = .41$, $p = .00$). The comparison between the two models of personality revealed that the AFM is more related to aggressive driving than BFM.

Keywords: Aggressive driving, the Big Five model, the Alternative Five model.

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Introduction

In the United States, motor vehicle accidents contribute to the category of unintentional injuries, which is the leading cause of death among persons between the ages of 1 and 44 (Heron, 2011; National Highway Traffic Safety Administration, 2007; Xu, Kochanek, Murhpy & Betzaida, 2010). The National Highway Traffic Safety Administration estimates that at least one-third of all motor vehicle accidents in the United States can be partially attributed to aggressive driving (Martinez, 1997). Last year only in the European Union there were 1.104.660 road accident victims (fatalities and injuries) with Romania being in the top of the list (European Commission – Annual Accident Report 2015). This fits the consensus in the research literature that aggressive driving increases the risk of motor vehicle accidents (Chliaoutakis et al., 2002; Galovski, Malta & Blanchard, 2006).

Given the massive cost of motor vehicle accidents and the importance of aggressive driving as a contributing factor, efforts to understand and ultimately prevent aggressive driving are of vital importance (Dahlen, Edwards, Tubré, Zyphur & Warren, 2012).

It is of high interest for both theorists and practitioners to review this particular area of transportation psychology and to determine the degree to which a specific result has been successfully replicated by a high number of studies. This would help theorists to revise definitions of specific concepts or improve the research methodologies. On the other hand, practitioners would benefit in knowing a central result on a specific theme, for example, to improve or modify the methods of testing people that apply for driver's license.

There are two presumed causal factors for this type of behaviour (i.e., aggressive driving): (1) situational factors and (2) individual factors. The present paper investigated a category of *individual factors* that could be associated with aggressive driving. Our choice in selecting the individual factors that could associate with aggressive driving is based on the fact that literature is more abundant in this regard, and on the fact that they account a significant percent (36%) of the variance in aggressive behaviours (e.g., Dahlen et al., 2012). These factors refer to personality, considered from two perspectives: Big Five Model (BFM; McCrae & Costa, 1987) and Alternative Five Model (AFM; Zuckerman, Kuhlman, Joireman, Teta,

& Kraft, 1993). For the current meta-analysis, we selected only three personality dimensions from each taxonomy. The reasons why we selected these two particular taxonomies are twofold: (1) both perspectives (especially the BFM) are widely used and culturally generalizable (Roland, 2002; Rossier et al., 2007); (2) BFM and AFM have documented overlaps (Zuckerman et al., 1993). Specifically, Zuckerman et al. (1993) demonstrated strong similarities through factor analysis between Extraversion vs. Sociability, Neuroticism vs. Neuroticism – Anxiety, Agreeableness vs. Aggression – Hostility (the first mention from the pairs is from FFM and the second from AFM). Thus, we want to explore which of the factors from the two theoretical perspectives that overlap is stronger associated with aggressive driving.

Hence, beside the goal of exploring the magnitude of the relationships between the personality dimensions and aggressive driving, it was also possible to assess which of them is more strongly related to the criterion.

The Five – factor model of personality

The Big Five model (McCrae & Costa, 1987) resulted from a lexical approach, and consists of 5 personality dimensions: Neuroticism, Agreeableness, Extraversion, Openness, and Conscientiousness.

Neuroticism corresponds to negative emotions such as fear, sadness, awkwardness, anger, guilt and disgust. Regarding the relationship between neuroticism and aggressive driving, the literature shows different levels of association. More precisely, some authors revealed a weak positive association (Benfield, Szlemko, & Bell, 2007; Britt & Garrity, 2006; Harris et al., 2014; Taubman – Ben-Ari, & Yehiel, 2012). Other authors showed an average positive association (Dahlen et al., 2012; Jovanović, Lipovac, Stanojević & Stanojević, 2011; Dahlen & White, 2006) and others identified a strong level of association (Qu et al., 2015; Aniței, Chraif, Burtăverde, & Mihăilă, 2014).

Extraversion refers to those individuals who are sociable, confident, active, talkative and who feel at ease among people and large groups. Some authors revealed a low positive association between extraversion and aggressive driving (Dahlen et al., 2012; Jovanović et al., 2011; Benfield et al., 2007; Britt & Garrity, 2006; Harris et al., 2014; Dahlen & White, 2006) and others showed that there is no association at all between these concepts (Dahlen & White, 2006).

Agreeableness is an interpersonal dimension, its essential aspects being altruism and cooperative behaviour. Dahlen and White (2006), and Britt and Garrity (2006) identified a low negative association between agreeableness and aggressive driving. Other authors also found an average negative association (Benfield et al., 2007; Aniței et al., 2014; Harris et al., 2014; Taubman – Ben-Ari, & Yehiel, 2012) and, furthermore, a high level of association between these constructs (Qu et al., 2015).

Building on the aforementioned theoretical arguments, we formulated the following questions:

Question 1: Is there a relationship between neuroticism and aggressive driving?

Question 2: Is there a relationship between extraversion and aggressive driving?

Question 3: Is there a relationship between agreeableness and aggressive driving?

The Alternative Five model of personality

The personality traits that comprise the Alternative Five model (Zuckerman et al., 1993) are Impulsive Sensation – Seeking, Aggression – Hostility, Neuroticism – Anxiety, Activity, and Sociability. These traits are basic personality dimensions, which resulted from a biological approach.

Neuroticism – Anxiety includes negative affective states, feelings of anxiety, emotional distress, hostility, excessive concerns, lack of self-confidence and sensitivity to criticism. Previous literature shows weak positive correlation with aggressive driving (Sârbescu, Costea, & Rusu, 2012; Sârbescu, 2012) and an average positive correlation, respectively (Poó & Ledesma, 2013).

Sociability represents those individuals who are likely to spend more time with friends, who engage in recreational activities and who often have an aversion to solitary activities. Previous results show weak positive associations with aggressive driving (Sârbescu, 2012; Sârbescu et al., 2012) and others show an association of an average value with this driving behaviour (Poó & Ledesma, 2013).

Aggression – Hostility refers to the propensity to adopt aggressive, reckless, antisocial, hateful and rude behaviours. Aggression – Hostility appears to have higher levels of associations than its equivalent (i.e., agreeableness). Specifically, Poó and Ledesma (2013) found an average positive association, and Sârbescu (2012) and Sârbescu et al. (2012) spotted a strong level of association.

Regarding the mixed results of previous literature, we formulated the next three questions:

Question 4: Is there a relationship between neuroticism – anxiety and aggressive driving?

Question 5: Is there a relationship between sociability and aggressive driving?

Question 6: Is there a relationship between aggression – hostility and aggressive driving?

Besides our attempt to synthesize previous results regarding the two models of personality and aggressive driving, we were also willing to identify the model of personality with the highest level of association to aggressive driving.

Method

Eligibility criteria

The eligibility criteria for this study were: (1) to report the correlations between personality from the perspective of the Big Five model or/and from the standpoint of the Alternative Five and aggressive driving, (2) English to be the primary language of the research articles.

Literature search and study selection

We conducted the literature search on several databases (e.g., PsycINFO, Google Scholar), using the following keywords: "Big Five Model" (Personality, Extraversion, Agreeableness, Neuroticism,) "Alternative Five Model" (Aggression-Hostility, Sociability, Neuroticism-Anxiety), "aggressive driving" and "dangerous driving".

Throughout the literature search, we selected only those studies that mentioned at least two variables of interest (i.e., driving behaviour - aggressive driving; and personality - Big Five Model / Alternative Five model). This process was conducted in June 2016 and yielded 78 titles. Seventy-three were retrieved in full-text (we had no

access to 5 of them) and were analyzed for eligibility by the first author. For more details, see Figure 1.

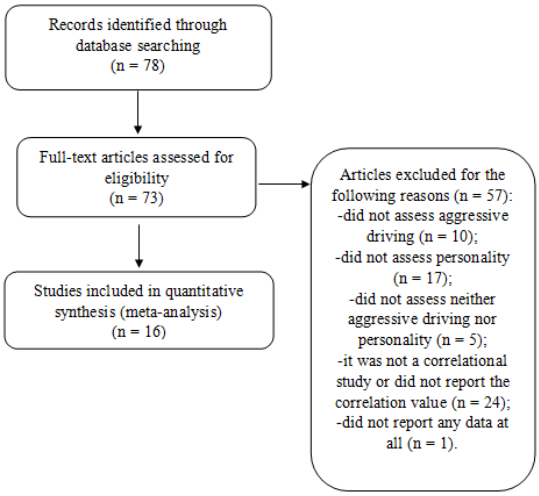

Figure 1. The flow-chart of the included studies

Study coding and data collection process

To accomplish this step, all authors extracted independently the studies' characteristics and the first author conducted a second independent verification. The following characteristics were extracted: identification data (author(s) and year of publication), sample size, sample type, mean age of the participants, the percentage of male participants, the nationality of the participants, instruments that measured the variables of interest (the Big Five model, the Alternative Five model, and aggressive driving), and r value.

Statistical analysis

To calculate the statistical indicators, we used Comprehensive Meta-Analysis version 2.0 software (Borenstein, Hedges, Higgins, & Rothstein, 2005). For an exhaustive analysis of the articles included in this meta-analysis, we assumed the random effects model (due to the mixed characteristics of the studies).

We took into account the following indicators: k (the number of studies included in the meta-analysis); N (the total number of the participants for each relationship); r value (which indicates the degree of association between the variables); z-score (indicates whether the observed result is robust); the lower limit and upper limit (the values of which will be found with a 95% certainty the average effect among the population of the studies); the indicators of homogeneity, namely I^2 and Q (which shows the degree of variation in the magnitude of effect sizes from one study to another), and $Q_{between}$ (which shows whether there is a significant difference between the two models of personality).

Regarding the publication bias, we considered the Funnel Plot – a plot of a measure of study size (usually standard error or precision) on the vertical axis as a function of effect size on the horizontal axis.

Results

Study characteristics

We selected the essential features of the included studies, in order to offer a better explanation of the results. Most of these features seemed quite mixed. That is, the samples included 6,721 students and other different categories of participants (e.g., general population - Jovanović et al., 2011; or field offices of the Office of Motor Vehicles – Dahlen et al., 2012), with mean ages between 18.71 and 37.89, and the gender distributions varying from 36% to 90.9% males. For an overview, see Appendix.

Mean effect size analysis

Regarding the Big Five model of personality, we found a weak effect size for the relationship between neuroticism and aggressive driving ($r = .26$, $p < .001$), a very weak relationship between extraversion and aggressive driving ($r = .07$, $p = .03$), and a weak effect size for agreeableness and aggressive driving ($r = -.26$, $p < .001$).

Regarding the Alternative Five model, we identified a weak effect size for neuroticism – anxiety ($r = .21$, $p = .05$), marginally significant weak effect for sociability ($r = .21$, $p = .06$), and a moderate effect size for aggression – hostility and aggressive driving ($r = .41$, $p = .00$).

The interpretation of these results is based on Evans' (1996) categorization of the levels of r values.

Despite the high number of robust relationships that we identified between these concepts, almost all of them (excepting aggression – hostility) did not share a common effect size (i.e., there was a high level of heterogeneity as revealed by the elevated levels of I^2 in combination with a statistically significant Q).

Q between index showed us there is no difference between neuroticism and neuroticism – anxiety and aggressive driving, but there is a difference regarding the effect sizes between extraversion and sociability in relationship to aggressive driving, and also between agreeableness and aggression – hostility as related to aggressive driving. In both cases the AFM dimensions exhibited stronger associations with the criteria than the BFM dimensions. For a better understanding of these results, see Table 1.

Moderator analysis

In order to explain the high level of heterogeneity of our results, we conducted moderation analyses. We found some significant moderators exclusively for the BFM, but because of the small number of included studies (i.e. three) we were not able to perform such analysis for the AFM. More precisely, for the relationship between neuroticism and aggressive driving, the nationality of the participants and the operationalization of personality seemed to explain some of the heterogeneity (for an overview, see Table 2). Therefore, there is a tendency towards stronger effects for the participants situated in European Union than for those in other states. Moreover, the relationship was also stronger in the studies that used exclusively International Personality Item Pool (IPIP; Goldberg, 1999) as compared to other Big Five personality measures (e.g., The Big Five Personality Factors, NEO-PI-R etc).

The $Q_{between}$ index showed non-significant effects between nationality (i.e., EU) or personality measure (i.e., IPIP) with regard to extraversion trait.

Regarding the relationship between agreeableness and aggressive driving, we found a significantly stronger mean effect for the studies that measured personality with other instruments than IPIP.

Publication bias

In order to investigate the presence of publication bias, we visually examined the funnel plots (see Figure 2). Unfortunately, we found high levels of asymmetry for all the links.

Table 1. Effect sizes for the different dimensions of personality and aggressive driving

The link between variables	*k*	*N*	*r*	*Z*	*95% CI*	*I²*	*Q*	*Q between*
N – AD	13	5321	.26	6.63**	.19 – .33	86.02	85.83**	0.25
N-Anx – AD	3	1400	.21	1.93*	-.00 – .41	92.48	26.61**	
E – AD	12	5026	.07	2.15*	.01 – .12	72.43	39.91**	4.29*
Sy – AD	3	1400	.21	1.91	-.01 – .41	92.46	26.52**	
A - AD	12	3683	-.26	-9.33**	-.31 - 0.21	60.82	28.08**	160.40**
Agg-Host – AD	3	1400	.41	13.16**	.36 – .47	24.77	2.66	

Notes: *p<.05; **p<.01; k= number of studies; r= mean effect size; z score= the ratio of weighted arithmetic average and standard error of mean; 95% CI= Confidence Interval with a certainty of 95%; I²= index of inconsistency effects; Q value= heterogeneity index; E=Extraversion, Sy=Sociability; N=Neuroticism, N-Anx=Neuroticism-Anxiety; A=Agreeableness, Agg-Host=Aggression-Hostility; AD=Aggressive Driving.

Table 2. Effect sizes for moderator categories

Moderator	*Variables*	*Category*	*k*	*N*	*r*	*95% CI*	*Q*	*Q between*	*P*
Nationality	N – AD	EU	3	1998	.30**	.25 - .34	4.45	13.44	.00
		Others	10	3323	.20**	.17 - .23	67.94**		
	E – AD	EU	3	1998	.11**	.07 - .16	14.61**	.43	.52
		Others	9	3028	.09**	.06 - 13	24.87**		
	A – AD	USA	4	1770	-.23**	-.27 - -.19	7.17	4.98	.08
		Others	7	1749	-.30**	-.34 - -.25	15.92**		
Personality measure	N – AD	IPIP	6	2824	.29**	.25 - .32	6.84	18.37	.00
		Others	7	2497	.18**	.14 - .21	60.62**		
	E – AD	IPIP	6	2824	.11**	.08 - .15	22.35**	.91	.34
		Others	6	2112	.09**	.04 - .13	16.65**		
	A – AD	IPIP	5	1186	-.20**	-.26 - -.15	6.28	6.68	.01
		Others	7	2497	-.29**	-.32 - -.25	15.11*		

Notes: *p<.05; **p<.01; k=number of studies; N=total number of participants; r=correlation value; 95% CI= Confidence Interval with a certainty of 95%; Q=heterogeneity index; $Q_{between}$=the difference between the two variables; p=the significance threshold; N=Neuroticism; E=Extraversion; A=Agreeableness; AD=Aggressive Driving.

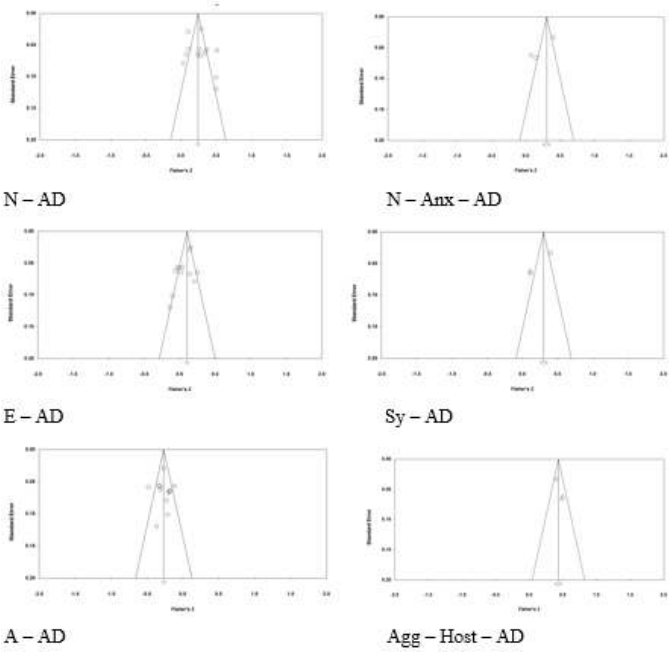

Figure 2. The funnel plot for each relationship

Discussion

The primary aim of this study was to synthesize the previous results with regard to personality traits that have a correspondent in each of the model of personality (i.e., BFM and AFM) in relation with aggressive driving. Secondly, we wanted to identify which of these models is stronger associated to the criterion.

As mentioned in the introduction, a previous study found that personality variables accounted for 36% of the variance in aggressive driving behaviours (Dahlen et al., 2012), hence a moderate towards strong effect. However, our meta-analysis showed that, for the three dimensions that overlap between BFM and AFM, the relationships range between very small to moderate. We will further discuss each of our findings separately.

Neuroticism and aggressive driving exhibited a weak association. One possible explanation for this result could be the Bettencourt et al.'s (2006) assertion that neuroticism is a special kind of aggression termed "reactive aggression" that arises in provocative situations, not in the neutral ones. Moreover, the increased heterogeneity of the included effects suggests that there could be many other factors that can be accountable for the way this association manifests. The moderator analyses that we conducted can partially clarify this assumption.

We found that nationality acted as a moderator. Namely, it seems that European residents with high neuroticism are more prone to such behaviours than other types of nationalities. Our interpretation of this result is based on the fact that some of these countries (e.g., Romania, Serbia) are characterized by a rising stress level, where the social support systems fail to offer the aid to the people who need it the most. For example, Ge et al. (2014) demonstrated in their study that global stress has a significant impact on dangerous driving behaviour and that it diminishes the driver's ability to concentrate on driving. Furthermore, these countries are collectivists, thus this ideology restrain the individuality and diversity by insisting upon a common social identity. Additionally, there are two types of collectivism, horizontal and vertical collectivism. Vertical collectivism is based on hierarchical structures of power and is therefore based on centralization. Both of them can alienate the individual and break his or her personal identity, which can lead to frustration and all characteristics typical to a high neuroticism and, in turn, to a high level of aggressive behaviours (inclusively while driving).

We also found a higher and homogeneous score when IPIP was used as a measure for personality. This is not surprising since this instrument has gained a high level of reliability and validity across cultures (e.g., Mlačić & Goldberg, 2007).

Regarding extraversion, we found a very weak level of association with aggressive driving. This finding is in line with Harris et al.'s (2014) assumption that this dimension of personality may be the most enigmatic of the Big Five dimensions to relate to aggressive driving. They also claimed that despite the fact that extraversion is defined, in part, by assertive and impulsive behaviour and positively associated with a variety of unsafe driving behaviours, the relationship between extraversion and aggressive driving remains fragmented and contradictory. Nonetheless, we succeeded to find that in reality there is a very weak level of association exclusively between these two concepts, and we found no significant moderators for this relationship.

We also found a weak level of association between agreeableness and aggressive driving. The moderator analyses showed that there is no difference between the residents of the USA and those of other nationalities. In turn, it seems that the operationalization of personality acted as an artifact. More precisely, the mean effect size resulted from the studies that used IPIP was significantly lower than the one based on all other measures. Agreeableness is an interpersonal dimension which requires altruism and cooperative behaviours. The negative poles of these two sub-dimensions are relevant with regard to aggressive driving. Other instruments used in the included studies, such as NEO-PI-R (Jovanović et al., 2011) or Big Five Adjective Checklist (Britt & Garrity, 2006), have broader operationalizations inclusively for the aforementioned facets. Therefore, this could be one reason for which we have found higher mean effect size for latter ones.

Moving to the AFM, we identified a weak positive association between neuroticism – anxiety and aggressive driving (i.e., there is a small chance as people who constantly feel negative affective states to appeal to aggressive behaviours towards other traffic participants). There are several explanations for this result. Firstly, it is very likely that feelings alone are not enough in determination of a specific negative behaviour towards others (e.g., yelling at a driver). Feeling negative affective states and having negative automatic thoughts simultaneously could determine the driver to behave aggressive in traffic. For example, having a high level of anxiety (i.e., the affective state) and being tired with concern to the traffic agglomeration (the negative thoughts) can push the individual to some contravening behaviours (showing the finger to another driver).

Secondly, there are situational factors that could alter this result (e.g., the existence and the status of the passengers in the car). For example, the constant endorsements made by an experienced passenger (the situational factor), together with a high level of anxiety of the novice driver (both personal and state traits) can push the driver to reckless actions towards other drivers using his or her own vehicle.

We also found a weak and non-significant association between sociability and the criterion. Being sociable requires spending time with friends and engaging in recreational activities which does not match with driving activities. More specifically, one does not have so many opportunities to be highly sociable in traffic compared to, for example, a party situation. Hence, this interpretation could explain the non-significant relationship between sociability and aggressive driving.

An exception of the pattern of these results is the one related to aggression – hostility and aggressive driving. This result is of moderate intensity. It seems that individuals who have this trait at a higher level are more likely to engage in aggressive behaviours while driving. This is not surprising since human aggression is an inborn trait (McDougall, 2015) which is quite similar with Zuckerman's biological approach with regard to his taxonomy. Thus, aggression itself is sufficient in determination of any type of aggressive behaviour, even aggressive driving.

Comparing the two models of personality, it seemed that between neuroticism and neuroticism-anxiety there is no statistical difference. Both of them have the same level of association with aggressive driving. Regarding

extraversion and sociability, the latter has a significantly stronger association to aggressive driving. Moreover, aggression-hostility has a significantly stronger association with aggressive driving than agreeableness.

One possible explanation is related to the low number of studies of the AFM (three studies). This fact has both advantages and disadvantages. The advantage is that the value of the correlations are higher, which means that personality accounted a high level of percent of the variance in aggressive driving behaviours. The disadvantage is that we cannot generalize these results.

Another possible explanation is related to the biological approach of AFM taxonomy, which is very similar in terms of emotions and feelings to aggressive behaviours, in this case, while driving. The present theoretical analysis resulted in an empirical discovery: aggression – hostility has the strongest association to aggressive driving. Besides high accessibility to guns (O' Donnell, 1995), global warming, and the widespread exposure to violent entertainment media (Bushman & Huesmann, 2001) there is the biological approach that arbitrate negative behaviours towards others.

Human aggression is any behaviour directed toward another individual with the intention to cause harm. On the other hand, hostile aggression has historically been conceived as being impulsive, thoughtless (i.e., unplanned), driven by anger, having the ultimate motive of harming the target, and occurring as a reaction to some perceived provocation. It is sometimes called affective, impulsive, or reactive aggression (Anderson & Bushman, 2002). These two distinct definitions contribute to an overview regarding the similarities and divergences between aggressive driving and aggression – hostility. As we can see, there are more similarities than differences between them. The only difference between them is the motive of harming, which is the main aim with regard to human aggression, and that last one with regard to hostile aggression. Therefore, there is no wonder why these two concepts relate to one another at such intensity.

Lastly, two of these studies took place in the same country (i.e., Romania). In this case, the target population is quite similar. This fact leads to significantly stronger association with aggressive driving than other studies with mixed samples.

Practical implications

The present study's results could be used in identifying novice drivers or at-risk professional drivers indirectly based on their personality profiles. Especially the AFM seems to have the most promising predictive value for aggressive driving. Therefore, the experts from transportation psychology should evaluate the possible risk for aggressive driving by using specific personality measures (e.g., ZKPQ).

Transportation psychology experts should also pay attention to other moderator analyses For example, European drivers are more prone to negative affective states than other nationalities Regarding the interventions aimed at decreasing the level of aggression, for example, group sessions of mindfulness on individualist states may not be as effective as in collectivist ones.

Limitations

Our results are highly heterogeneous, due to, for example, the high diversity of personality and aggressive driving operationalizations or the varied samples. Further, there is a high level of imbalance with regard to the two models of personality (i.e., BFM and AFM). The BFM integrated 13 studies, whilst the AFM integrated only 3 studies. Thus, the interpretation of the results of AFM are hardly generalizable. For this reason, we conducted moderator analysis only on the BFM.

Ultimately, understanding the role of personality in predicting aggressive driving could be restrained by the fact that we did not take into account all of the dimensions of the two models of personality.

Future directions

We suggest that future research should investigate extensively the AFM in relationship with aggressive driving, since it seems to exhibit stronger associations with this sort of behaviour. Future meta-analyses on individual differences correlates of aggressive driving should also consider the other dimensions of BFM and AFM for a more comprehensive view (i.e, Conscientiousness, Openness; Activity and Impulsive – Sensation Seeking). For example, many previous studies found that sensation-seeking played an important role in predicting aggressive driving behaviour (e.g., Dahlen, Martin, Ragan & Kuhlman, 2005; Dahlen & White, 2006). Conscientiousness should not be neglected either. In this case even more studies show convergent results (e.g., Dahlen & White, 2006; Dahlen et al., 2012; Harris et al., 2014; Jovanović et al., 2011).

The BFM and AFM do not represent the single models of personality that predict aggressive driving. For example, future research could associate the Eysenck model to this criterion (Harris & Houston, 2010; Lajunen & Parker, 2001).

Additionally, situational factors could also play a role in determining the aggressive behaviour while driving. For instance, they could refer to the existence and status of passengers in the car (Porter & Berry, 2001), since groups are invariably more aggressive than individuals (Smith & Bond, 2006).

Conclusion

The attainment of the present paper contributes in an exhaustive manner to understanding the relationship between the two acknowledged models of personality and a particular category of driving behaviour, namely aggressive driving.

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Appendix

Study characteristics

Study	*N*	*Sample*	*MAge*	*% male*	*Personality measures*	*Aggressive driving measures*	*Nationality*
1.Britt & Garrity (2006)	164	Students	19	39	Big Five adjective checklist (John, Donahue, & Kettle, 1990)	Situational questions regarding three specific anger provoking situation when driving (tailgate, cut off, slow), created by the authors	USA
2.Aniței et al. (2014)	100	Students	20.68	36	IPIP-50 (Goldberg, 1992)	AVIS (Aggressive driving behaviour - Benesch, 2011)	Romania
3.Dahlen & White (2006)	312	Students	-	-	IPIP-50 (Goldberg, 1999)	Driving Survey (Deffenbacher et al., 2000); DAS (Deffenbacher et al., 1994)	USA
4.Benfield et al. (2007)	204	Students	18.71	41.37	The Big Five Inventory-54-item (John, & Srivastava, 1999)	DAX (Deffenbacher et al., 2002); DATQ (Driver Angry Thoughts Questionnaire - Deffenbacher, Petrilli, Lynch, Oetting, & Swaim, 2003); DAS (Deffenbacher et al., 2002)	USA
5.Harris et al. (2014)	1181	Students	-	-	Big Five Index (BFI; John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008)	Aggressive Driving Behaviour Scale (Houston et al., 2003)	USA
6.Jovanović et al. (2011)	260	Other than students	32.5	52.7	NEO-PI-R-60 (Djurić-Jočić et al., 2004)	DAX (Deffenbacher et al., 2002); UKDAS (Lajunen et al., 1998)	Serbia
7.Dahlen et al. (2012)	308	Other than students	37.89	41.88	IPIP (Goldberg, 1999)	DAX (Deffenbacher et al., 2002); DAS-14 (Deffenbacher et al., 1994)	Australia
8.Sârbescu (2012)	262	Other than students	28.17	90.8	ZKPQ-99 (Zuckerman et al., 1993)	DAX (Deffenbacher et al., 2002)	Romania
9.Sarma et al. (2013)	1638	Other than students	35.95	55.1	IPIP-30 (Goldberg, 1999)	DAS (Deffenbacher et al., 1994)	Ireland
10.Qu et al. (2015)	295	Other than students	37.34	50.16	Big Five Inventory (John, & Srivastava, 1999)	DDDI (Dula, & Ballard, 2003)	China
11.Sârbescu et al. (2012)	230	Students + other types of	27.36	90.9	ZKPQ (Zuckerman et al., 1993)	DAX (Deffenbacher et al., 2002)	Romania

Study	*N*	*Sample*	*MAge*	*% male*	*Personality measures*	*Aggressive driving measures*	*Nationality*
		participants					
12.Taubman - Ben-Ari & Yehiel (2012)	320	Students + other types of participants	35.13	46.88	The Big Five Personality Factors (John, & Srivastava, 1999)	Multidimensional Driving Style Inventory (Taubman-Ben-Ari et al., 2004)	Israel
13.Yang et al. (2013)	224	Students + other types of participants	-	36.6	IPIP (Goldberg, 1999)	DBQ	China
14.Poó & Ledesma (2013)	908	Students + other types of participants	36.2	57.7	ZKPQ-50-CC (Aluja et al., 2006)	Multidimensional Driving Style Inventory (Poó, 2013)	Argentina
15.Ge et al. (2014)	242	Students + other types of participants	35.75	49.27	IPIP (Goldberg et al., 2006)	DDDI (Dula & Ballard, 2003)	China
16.Schwebel et al. (2006)	73	Students	27.82	41	The Big Five Inventory (BFI; Benet-Martinez and John, 1998)	The Driving Anger Scale (DAS; Deffenbacher et al., 1994, 2001)	USA

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Selection of spatial reference frames depends on task's demands

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Spatial reference frames (SRF) are the means of representing spatial relations or locations either in an egocentric coordinate system (centred on navigator) or in an allocentric coordinate system (Centred on object). It is necessary to understand when and how spatial representation switches between allocentric and egocentric reference frames in context to spatial tasks. The objective of this study was to explore if the elementary spatial representation does exist, whether it would remain consistent or change under the influence of a task's demand. Also, we explored how the SRF would assist if the environment is enriched with landmarks, having multiple routes for wayfinding. The results showed that the switching of SRF depends not only on the default representation but also on a task's demand. They also demonstrated that participants who were using allocentric representation performed better in the presence of landmarks.

Keywords: Spatial Representation, Spatial Visualization, Spatial Updating, Spatial Orientation, Virtual Reality.

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Introduction

Reference frame (RF) is the way by which the brain represents spatial locations or relations that can be either an object centred (allocentric/intrinsic frame of reference) or body centred (egocentric/relative frame of reference) (Klatzky, 1998). It is important to address problem of how brain (physical entity) represent itself in an objective world in terms of spatial relations (Grush, 2000). Extending to the problem, Grush (2000) classified different spatial representations into the categories of egocentric space(up , here etc.), egocentric space with a non ego object reference point (left , right etc.),object centred reference frame, virtual point of view (neutral perspective) and objective or nemocentric maps. The last two of these five classes referred to allocentric space.

If we include only one kind of spatial relation and expresses locations relative to one point of reference, then it will be defined as elementary spatial representation (Meilinger & Vosgerau, 2010). Elementary spatial representation refers to a person's default predilection for using either egocentric or allocentric spatial representation when carrying out spatial tasks. In egocentric RF, coordinates of spatial locations are oriented towards navigators and they constantly get updated during movements(i.e. sensorimotor contingencies) while in an allocentric RF, coordinates of spatial locations are independent of the observer's location and are assigned through relations built on the objects and the environmental layout. The dichotomy in spatial reference frame is also supported in the neuroscience research. For example, there exists different neural structures and visual processing pathways for egocentric and allocentric RFs (Galati, Lobel, Vallar, Berthoz, Pizzamiglio, and Le Bihan, 2000 and Holdstock, Mayes, Cezayirli, Isaac, Aggleton, and Roberts, 2000).

Although researches have been more focused on adult population, we chose adolescent for our study. One of the reasons was to explore variation of these representations in the adolescence period which could be benefited from more engagement of participants for the given tasks. However, in children, different developmental trajectories of spatial representation are seen from birth(body centred) to age of 3 to 6 years(object centred) (Nardini, Burgess, Breckenridge, and Atkinson, 2006) which is not affecting factor in our sample . Along with it, teenagers get ability of informal deductions by this age which is one of the required components in a spatial ability. It should be noted that despite the distinction between teenager and children, we used the 'children' interchangeably to refer to the adolescent participants.

Spatial representation is crucial in functioning of everyday life, such as updating orientation or maintaining visuospatial abilities. The role of elementary spatial representation in performing tasks, which require spatial ability, is important. Lot of researchers have quantitatively

identified the role of spatial representation in object visualisation (Asakura & Inui, 2011), orientation (Hegarty, & Waller, 2005), wayfinding (Goeke, Kornpetpanee, Koster, Fernandez-Revelles, Gramann, and Konig, 2015), and spatial updating (Burgess, 2006; Tsuchiai, Matsumiya, Kuriki, and Shioiri, 2012; Wang & Spelke, 2002). Very few of them have explored spatial representation in children for various spatial abilities (Bernardino, Mouga, Castelo-Branco, and van Asselen, 2013; Broadbent, Farran, and Tolmie, 2014; Broadbent, Farran, and Tolmie, 2015), but none of them examined teenager. This study assess the role of spatial representation in spatial ability employed in various spatial tasks and wayfinding. In this study, spatial tasks encompass spatial abilities for spatial visualisation, spatial orientation and spatial updating.

Spatial Visualisation is the ability to imagine an object's spatial form and its movement in a desired way. The most commonly used task for measuring this ability is the mental rotation (MR), in which two shapes are compared as similar or different. Several studies of mental rotation have revealed that it requires an object-based spatial transformation irrespective of the egocentric reference frame (Asakura & Inui, 2011; Pani & Dupree, 1994). This reflects that allocentric based transformation is required in mental rotation. We considered object intrinsic reference frame to be equivalent allocentric reference frame following previous works (Campbell, 1995; Levinson, 1996). An assumption that can be formulated based on previous findings is that an individual employing allocentric frame of reference performs better in mental rotation. Another spatial ability, spatial orientation, is defined as the ability to imagine the appearance of objects from different orientations (perspectives) of the observer (McGee, 1979). The test used for this ability is perspective taking test (PT) which is based on egocentric-based spatial transformation (Kozhevnikov & Hegarty, 2001).We assume that an individual who adopt to the egocentric reference frame would perform better in PT.

Spatial updating is a cognitive process that requires the observer to maintain relation between himself/herself and external objects and generate corresponding internal representation in spatial memory. Commonly used task to assess this ability is table top display (TT) task that elicits the representation of spatial relations in memory. These spatial relations can either be egocentric or allocentric. Egocentric relation in spatial memory is influenced by the observer's perspective (Wang & Spelke, 2002) while allocentric relation is influenced by the background objects or the intrinsic orientation of the spatial array (Mou, Fan, McNamara, and Owen, 2008a; Mou, Xiao, and McNamara, 2008b). To summarise, there are two hypotheses for spatial updating, one is egocentric updating hypothesis (Wang & Spelke, 2002) while the other is allocentric updating hypothesis. According to the egocentric updating hypothesis, as we move or when we imagine movement, we update spatial information with respect to the self in the representation of spatial memory (Wang et al., 2006). According to allocentric updating hypothesis, spatial information is updated with respect to objects and environment. To reproduce the information, there is a perpetual debate in literature that if both spatial representations exist together one of them is dominant. Here, in this study, we considered that allocentric reference frame will dominate in TT task, since only table rotation task was performed.

Wayfinding is defined as finding a route from a starting point to a goal. Wayfinding is routine based activity in which efficient route learning is dominated by two strategies, 'landmark-based strategy' and 'directional strategy'. In 'landmark-based strategy', route finding is assisted by easily visible landmarks more synonym with allocentric representation while 'directional strategy' depends on the turns and sensorimotor contingencies, more synonym with egocentric representation. For successful wayfinding in children, landmarks are considered to be a very crucial factor (Kitchin & Blades, 2002; Jansen-Osmann, 2002; Lingwood, Blades, Farran, Courbois, and Matthews, 2015). A recent study demonstrated that route learning based on directions develop after age of 10 and labelled landmarks improved wayfinding in children (Lingwood et al., 2015). This suggests that root cause of these strategies might be use of different spatial representation. For example, a study showed that removal of landmarks pushed typically developing children to adopt sequential egocentric coding for taking directions (Broadbent et al., 2015). Most of the studies focused on importance of landmarks for wayfinding with a single solution(one solution to reach the destination). An important question that needs to be addressed is how landmarks would facilitate wayfinding if there are multiple possible paths i.e. more than one solution to reach the destination. In summary, labelled landmarks would facilitate wayfinding and allocentric RF would dominate in the presence of landmark.

To design the spatial task for spatial orientation (PT), spatial visualisation (MR), spatial updating (TT) and wayfinding(Virtual Maze), there is an intermittent need for precise control of stimuli along with attractive features provided by virtual reality (VR). Virtual reality (VR) provides immersivity which engage participants, especially children, in the task (Parsons & Khosrow-Pour, 2015). Moreover, VR increases the sensory responsiveness of the subject because the subject is not a mere observer but a performer in that task. In addition, it minimizes the omission errors. Therefore, it is a very promising contrivance in assessing spatial tasks more accurately (Freksa, 2013).

Present study

To empirically assess the role of spatial representation in performing a spatial task and wayfinding, we attempt to explore two following objectives, based on the previous studies:

1. If elementary spatial representation does exist then it would remain invariant for short duration spatial tasks which are time bound.

It means that if an individual is classified with respect to his/her default reference frames then he/she would use the same reference frame in all the spatial tasks, even if the task demand would invoke a different strategy. Testing of this hypothesis has been done by examining participants using egocentric and allocentric representations. If the hypothesis is true, participants using allocentric approach would perform better in TT and MR tasks, and participants using egocentric approach would perform better in PT task.

2. If the environment is enriched with landmarks with multiple routes for wayfinding, the participants who are using allocentric reference frame would be more successful in comparison to the participants who would use egocentric reference frame.

Landmarks would facilitate children to complete wayfinding faster in comparison to a virtual maze without landmarks. A landmark enriched environment would facilitate allocentric representation and hence, children

using allocentric representation will perform better in a maze with landmarks.

Method

Participants

A total of 65 participants (mean age = 13 years, 30 female and 35 male) were taken volunteered for this study. All of them were right handed, except one male participant. Information consent form was filled by their parents. Consent form was also obtained from the school for conducting the study in their premises. There was no abnormality or learning disorder in the participants and this inference was drawn after interviewing the parents and teachers. Duration for all the experiments put together was one hour. Roughly fifteen minutes were spent in making the children get an idea about the virtual reality technology, the importance of the tasks to be performed, and to habituate them with the computer and mouse.

Apparatus and materials

Animal in a Row Task:

"Animals in a row" task was designed for non-verbal spatial encoding. The main paradigm was adapted from a task developed by Levinson & Schmitt (1993). This task was used to classify participants on the basis of their default reference frame which can be either egocentric or allocentric. Stimuli consisted of three sets of three small toy objects (Animal figures), each of which had a salient front and back. These were placed in a row perpendicular to and in front of the subject, with the "face" of the object toward the subject.

Virtual Environment:

Four different virtual reality tasks were created using Unity 5.1, which included scripting in C\# and java. VE was presented to the participants using a 15.6 inch HD display in a 16:9 widescreen. Distance between the user and the screen was 55 cm. Participants performed the task using a keyboard and mouse.

Table top display task:

Ten objects having no semantic relations were displayed over a table in random order (Fig.1). Participants were instructed for 10 seconds to remember the objects and their spatial layout. After 10 seconds, four objects disappeared from the table for 5 seconds. They subsequently reappeared, but spatial layout was rearranged by rotating them for 180 degrees clockwise. Now the subjects were told to click on the objects which they thought had disappeared. Number of correct selection of objects, commission and omission errors and response time were taken as the factors to be considered for scoring.

Figure 1. Stimuli presentation in table top display task

Mental Rotation:

Subjects were instructed to compare two figures and then respond whether they were similar or dissimilar (Fig.2). The figures were so screened that the difficulty in understanding them was minimal as the subjects were children. Maximum rotation difference was limited to 180 degrees. A total of ten stimuli were provided to the subjects, with a maximum response time of 15 seconds/stimuli, including the participants' response. Correct response and response time were taken as MR scores.

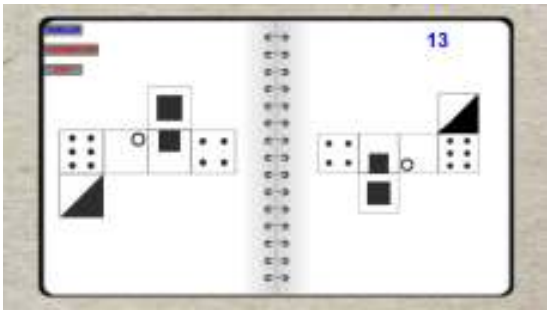

Figure 2. Stimuli presentation in mental rotation task

Perspective Taking Test:

This test was adopted from the perspective taking test of Kozhevnikow and Hegarty (2001). A total of seven objects in a fixed array were shown to the participants. On each item, the participant was asked to imagine being at the position of one object in the display (the station point) facing another object (defining their imagined heading or perspective within the array) and was asked to indicate the direction to a third (target) object (Fig.3). The task was to draw another arrow from the centre of the circle indicating the direction to the target object (e.g. the flower). A total of 12 stimuli were presented to the subject. A total of 30 seconds were given to the participants for making the imagined perspective and then drawing the angle. If the participants responded before 30 seconds, the second stimuli would appear immediately after pressing the next button. Deviations from the correct answer and response accuracy were taken as scores.

Figure 3. Stimuli presentation in perspective taking task (array of object is constant while perspective is changed with each trial)

Figure 4. Response format in perspective taking task

Virtual maze:

The demo maze was similar to the test maze to get the children acquainted with the task (Fig.5). It had many landmarks and one solution. The test maze had four varieties. These varieties were designed to identify the efficiency of finding a solution and the role of landmarks in wayfinding. The task was to find a path from home to school. The four varieties included single path (SP), single path with landmark (SPLM), multiple paths (MP) and multiple paths with landmark (MPLM). Single path constituted only one solution available to the participant for wayfinding, whereas multiple paths constituted more than one solution. In this experiment, the participants were instructed to choose the shortest path. Each variety had two types except MP; seven mazes were shown to the participants. In each maze the subjects were instructed to find out the path from home to school. Time taken to plan the route was considered to be the planning time. When the subject had found the path or found the solution then he/she clicked on "play" button and started moving from home to school through keypad arrow key. The time taken to complete the navigation was termed as navigation time. The total time taken on the task was the sum of planning time and navigation time. A maze with landmarks helped them in finding a solution much faster because the following instruction was given to them: "Shortest path includes x, y and z in your way". Here x, y and z represented different landmarks. In this research study, a total of 8 landmarks were chosen: Bakery shops, mall, grocery store, metro, car parking, cinema hall, stationary shop and a defence organisation. Scores were taken in the form of planning time and total time taken to complete the task. Complexity in wayfinding was balanced in all the mazes

Figure 5. Demo version of the virtual maze

Procedure

The experiment was conducted in an interference-free environment to prevent the participants from getting distracted. Based on the Animal in a row task, the participants were qualitatively classified as adhering to an allocentric or egocentric spatial reference frame. There were three trials in this task. For each trial, two square tables were placed such that a small space was left between them; the subject stood between the two tables and looked toward one of them. The three objects were then placed in a horizontal row on the table in front of the subject, equidistant from each another. The interviewer then pointed to each object in a randomly-selected order, and asked the subject to identify each object placed on the table twice, first by name and then by colour. This was done so that the subject attends to each object in the scene without explicitly invoking spatial language.

The participants had to memorize an array of objects (fish, octopus and scorpion) for some time (15 sec). After some delay, the participants were asked to close their eyes and rotate by an angle of 180 degrees. Then they were shown five objects (an extra shark and a tortoise) and identify three objects from them. This three-of-five procedure was used to increase memory demand and mask the spatial nature of our task.

They were instructed to place the identified objects "in the same way as before" on the table. The participants responded either with absolute placement or relative placement, which then categorised them as allocentric or egocentric respectively. After participant's classification based on their use of default reference frame, next four stimuli were presented in a random order to eliminate any possible sequence effects or any kind of exposure.

The participants handled the mental rotation task, commeasuring to the given instructions. A brief demo was provided to the participants to familiarise them. Similarly, the participants had to undergo the perspective taking test, table-top display test and the virtual maze, in that particular order. Of course, they were aided if they could not grasp the instructions or could not understand the environment. All the trials were presented in a randomised order to counterbalance between participants. For the convenience of the experiment, participants with an allocentric representation were referred to as the group 'A' and participants with an egocentric representation were referred to as the group 'E'.

Results

The "Animal in a Row" task classified 65 students into the group A (25 students) and group E(40 students) with respect to object placement on a table. According to the classification, scores were distributed among groups and further evaluated using statistics in R 3.0. Descriptive statistics of scores are displayed in Table-1(MR, PT, and TT) and Table-2 (VM). To avoid any gender biases in our results, we did Pearson Chi Square statistics to identify effect of gender on variables of the spatial tasks. There was no effect of gender on the PTA, $\chi^2(2, n=64)=0.1773, p>0.05$, MR, χ^2 $(3, n=59) =1.55, p>0.05$, and TT, χ^2 $(3,n=64)= 0.44, p>0.05$. Group E had more correct responses, $t(58)=0.68, p>0.05$, and less response time, $t(58)=1.32, p>0.05$ in MR task, while, Group A had a greater response accuracy(correct answers/number of stimuli attempted), $t(63)=0.49, p>0.05$, along with more

deviation, t(63)=0.35, p>0.05 in PTA task. In TT task, group E had more number of correct responses, t(63)=0.36, p>0.05,with more errors, t(63)=0.76, p>0.05, and less response time, t(63)=0.34, p>0.05. We calculated percentage accuracy (maximum correct response covered by group/ total number of correct response *100) assess performance in group. Percentage accuracy for correct response in each task, Mental rotation (group A=49.56\% , group E=52.97\%), Perspective taking test (group A=55.13\%, group E=41.56\%) , and table top display (group A=47.82\%, group E=50\%), was in concurrency of above stated findings.

One-way ANOVA was applied on the obtained variables of virtual maze. Group A showed lesser planning time for the maze having landmarks, F(1,59)=4.37, P>0.05, while, Group E showed lesser total time for single path, F(1,59)=5.26, P>0.05,and multiple path, F(1,59)=8.19, P>0.05. Both groups had lesser total time for maze enriched in landmarks. Group A took less time in reaching destination for multiple path with landmarks, F(1,59)=6.18, P<0.05, shown in table 3.

Table 1. Descriptive statistics in group A (Allocentric reference frame) and group E (Egocentric reference frame).

Task	*Scoring variable*	*Group E*		*Group A*	
		Mean	*SD*	*Mean*	*SD*
Mental Rotation	Correct Response	5.29	1.41	4.95	1.46
	Response time (in second)	7.66	2.05	7.27	1.52
Perspective Taking Test	Deviation from correct response	26.77	82.91	34.64	71.44
	Response accuracy	29.93	17.22	31.97	17.22
Table Top Display	Correct Response	3.69	1.37	3.54	1.71
	Response Time	35.05	14.91	38.76	34.22
	Commission Error	1.7	0.91	1.64	1.18
	Omission Error	2.00	0.96	1.92	0.86

Table 2. Performance of groups in different types of virtual maze

Groups	*Varieties in maze*	*Planning*		*Total time taken*	
		Mean	*SD*	*Mean*	*SD*
Allocentric	SP1	34.86	35.78	79.50	49.31
	SP2	50.91	40.28	114.16	62.12
	SPLM1	19.13	14.45	50.64	18.13
	SPLM2	29.71	21.23	77.18	32.30
	MP	28.00	21.29	61.81	30.53
	MPLM1	26.26	13.78	60.54	23.43
	MPLM2	26.00	16.76	53.08	18.41
Egocentric	SP1	30.21	17.57	58.97	20.87
	SP2	52.28	51.90	110.00	60.23
	SPLM1	23.29	19.57	57.45	38.45
	SPLM2	31.72	28.98	78.23	39.69
	MP	27.36	17.58	43.18	19.53
	MPLM1	39.46	26.91	59.85	39.96
	MPLM2	32.05	21.11	70.00	28.65

Table 3. Independent sample t-test differences between the two groups

Type of Virtual Maze	*T test value for total time taken*
SP1	5.26*
SP2	0.55
SPLM1	0.90
SPLM2	0.01
MP	8.19**
MPLM1	0.02
MPLM2	6.18*

Notes: * $p < .05$, ** $p < .01$.

Discussion

The present study explored the role of allocentric vs. egocentric spatial representation in various spatial task and wayfinding. It also addressed the influence of spatial representations during performance when labelled landmark was presented in virtual maze. The question addressed in the study was: In case of a time bound task, would a subject use the default reference frame or not? In this paper, the hypothesis 1 states if it is classified that a participant uses a particular spatial representation for performing a spatial task(which is termed as default in this paper) , then would he/she use the same representation in all the spatial tasks, irrespective of their individual and task

demands. For MR and PT tasks, we inferred from previous researches that the participant using an allocentric representation would perform better in the former task and the participant using an egocentric representation would perform better in the latter task (Hegarty & Waller, 2004; Menchaca-Brandan, Liu, Oman, and Natapo, 2007). Our result showed that participants who were classified in group A had more response accuracy in Perspective taking test, while participants who were classified in group E had more correct response in mental rotation task. This result contradicted the assumption; therefore, the hypothesis was rejected. Inference could be drawn that if a person has been classified to be using a certain spatial reference frame, he/she can switch over to the other reference frame, based on the demands of the task. Consistent with the earlier research, the results indicated that both the abilities (spatial visualisation and spatial orientation) were dissociated on the basis of applied spatial transformation strategies ((Hegarty & Waller, 2004; Menchaca-Brandan et al., 2007) These strategies are determined on the basis of spatial representation for a particular task. If participants are classified on the basis of their default spatial representation for small scale scene, then probability of choosing that representation in another spatial task increases. When properties of the task demand for the strategy (or working out with different spatial relation/representation) different from the default one, the participant's load increase, and he can either switch to other strategy or use default one. Time consumption increases while utilising default spatial representation for opposing demands as evident from deviated outcome of expectation for MR and PT tasks in group A and group E respectively.

In case of the TT, participants using an allocentric representation would perform better because the observer's locomotion was static. Results showed that Group E had a higher score and shorter response time which disagreed with our assumptions. Participants having egocentric representation performed better because there was no need for them to switch over from a transient to an enduring representation owing to its pronounced effect on disorientation (Waller & Hodgson, 2006). Since the task was displayed in VR without adding any environmental boundaries, the ego group had a greater score (Burgess, Spiers, and Paleologou, 2004). However, rise in errors indicated participants of group E had lack of alignment of the intrinsic axis over the imagined viewpoints. In addition, the locations of the objects were also stored along with the intrinsic axis, which reduced the errors in the allocentric representation (Burgess, 2006). Therefore, we concluded that first hypothesis could not be accepted for spatial updating task, according to which, if one uses default reference frame, it might not be necessary that the spatial updating would also be in the same reference frame.

For spatial tasks like mental rotation, perspective and table-top display task, first hypothesis was rejected. The major reason for the rejection of hypothesis could be that the priority of selection would be higher for default/habitual spatial representation, but the probability of switching between the representations becomes predominant when task demands different strategy. The proportion and amount of change in the representation is in itself flummoxing, which can become part of future research.

In wayfinding task, our assumptions were that egocentric approach would be better in case of no landmarks and allocentric approach would otherwise be better. The virtual maze enriched in landmarks had facilitated wayfinding, putting emphasis on importance of landmarks for the participants. These findings matched with the previous results (Lingwood et al., 2015), though they pertain to only single-path solutions. There is only one way to reach one's home from the target location. According to our knowledge, no one has specifically worked on multiple-path solutions for children in which there are multiple paths to reach one's home from the target location. Our results demonstrated that in multiple-path solution, both the groups took less time when compared to single-path solution. It means that when people were given choices, the teenager's way finding ability increased, because multiple solutions increase the likelihood of way finding by decreasing the problem space.

As expected, Group A performed better than Group E in wayfinding provided there were landmarks. On the account of the gathered results, it was speculated that the probability of choosing the default reference frame increases in certain given conditions for wayfinding. The given conditions in our experiment were: a) no time limitation, b) retracing the path to the destination from origin was not allowed and c) the view of the participant should not change (i.e. the home and the target should be displayed on a single screen). Thus, summarising the wayfinding task provided the certain conditions mentioned above, both the hypotheses were accepted.

Conclusion

To sum up, the objective of this study has been to find out whether default spatial representation differs or remains the same in different spatial tasks utilizing different spatial ability. In addition, this study intended to test how these spatial representations help an individual when he/she is facing a problem with multiple possible paths in the presence of landmarks and without landmarks. Result suggests that if an individual is using a particular type of representation for a particular task, it is possible for him/her to effectively switch over from one representation to another for a different task. We bring it to the knowledge of the readers that the spatial representation is elementary in nature as some groups acknowledged that it could be sequential or parallel as well. The findings suggest that children could switch over from one spatial representation to another or could stick to their spatial representation. It was also shown that the landmarks, which facilitated wayfinding with multiple-paths and also that children using an allocentric representation performed better. What makes this study stand out is that it attempts at gauging the overall spatial ability in children through wayfinding, something that has not been explored so far. Also, it contributes in ameliorating the draught of work pertaining to classifying reference frames in the field of spatial cognition. Yet another factor that renders this study unique lies in the fact that although research so far has been done with children subjected to a maze, no work had been thoroughly dedicated to check the efficacy of the landmark approach in the case of multiple possible solutions to reach a goal.

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The influence of learning context of implementation intentions over the increase in fruit consumption: Preliminary results from a pilot study

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The present research is aiming to investigate the influence of the context of learning implementation intentions over the efficiency of the intervention. 73 participants enrolled for participation in this study. They learned a behavioral self-regulation strategy meant to help them implement their intentions to increase fruit consumption. The participants were randomized in one of the three experimental conditions: ego-depletion, control, hopelessness. All the participants, regardless of the experimental condition they were assigned to, where given a presentation on implementation intentions. They all designed "if-then" plans to increase fruit consumption. The pretest results concerning fruit consumption within the 48 hours before participation showed that approximately half of the participants already eat more than three fruits within the last 48 hours before pretest. Hence we decided to exclude them from the analysis, because they would benefit less from implementing an implementation intention strategy as they are already eating at least two fruits / day as a minimum intake. The preliminary analyses made on the retained sample showed that there are no significant differences between the three experimental conditions regarding a change in quantity, calories or pieces of fruit from fruit intake. Even though the results are not statistically significant, in this pilot study we have noticed a descriptive trend suggesting that the ego-depletion effect might be less intense and transitory because the fruit intake (quantity, calories and pieces), at 96 hours after the experiment, seems to be almost the same as it was in pretest.

Keywords: Learning context, Implementation intentions, Ego-depletion, Hopelessness, Healthy food.

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Introduction

Regular intake of fruits and vegetables is associated with a lower risk for developing cancer, cardiovascular diseases, stroke, and Alzheimer's disease. Even the deterioration associated with normal aging seems to be slowed down for people that have a regular intake of fruit and vegetables (Liu, 2003). Eating citrus and vegetables that contain carotene has proven beneficial in reducing the risks for developing cancer (Liu, 2003). Also, it seems that dietary supplements do not have the same health benefits as fruit consumption (Liu, 2003).

Most people are aware of the benefits brought by a healthy diet (O'Brien and Davies, 2007) and are motivated to eat healthily. However, studies show that even if people intend to eat healthy food, very few succeed in doing so (Kumanyika et al., 2000). Merely having an intention is not enough to initiate the desired behavior (Webb and Sheeran, 2008). For instance, that "I intend to eat more fruit" does not guarantee that I will eat more fruit. The intention does not necessarily determine the intended behavior because initiating this behavior depends on of a series of psychological resources like memory, attention span, or self-control. In some situations, people forget the intentions they have or do not seize the opportunities that would help them behave according to their intentions. Baumeister, Bratslavsky, Muraven and Tice (1998) state that in order to initiate an intended behavior, an individual needs to have the necessary psychological resources. The self is responsible for initiating behavior, making decisions, and inhibiting certain behaviors. To accomplish these tasks, certain resources need to be available. Individuals don't have a constant and planned control over their self, and this fact is supported by the studies that show how individual's behaviors are sometimes influenced by automated or unconscious processes (Bargh, 1994; Chen and Bargh, 1997). Hence, some parts of the self are involved in deliberative, conscious answers, and this

particular part of the self can be extremely important for the long-term health of the individual. The core idea is that ego-depletion determines a limitation of resources for willpower, which means that a previous effort of will can undermine the strength of a future act of will. Research has shown that resisting the temptation to eat chocolate can "tire" a person up, and subsequently make him/her quit the effort of accomplishing a frustrating cognitive task. This suggests that the two self-control acts draw from the same limited resources. Hence, the term ego-depletion is used whenever we speak of a temporary decrease in the self-capacity of engaging in acts of willpower, as a consequence of a previous act of will (Baumeister et al., 1998). Ego depletion contributes to a self-regulation break-down, and this can subsequently undermine goal achievement (Gollwitzer and Sheeran, 2006). For instance, when we are tired, it's possible that we fail to remember our intentions, or we can even miss opportunities to act according to our intentions (Gollwitzer and Sheeran, 2006). Nonetheless, it is possible to act according to the intentions we established, even if the psychological resources we have at the moment are low.

A behavioral self-regulation technique that helps us translate our intentions into behavior is implementation intention (Gollwitzer, 1999). This technique advises to build "if-then" plans and has proven efficient in changing various behaviors (Gollwitzer, 1999). In latest years, research has focused on comprehending the mechanism underlying implementation intention, to increase the efficiency of interventions that aim to change behavior (Gollwitzer and Sheeran, 2006).

There are two processes that contribute to the efficiency of implementation intention in promoting goal-directed behavior. The first process implies to anticipate and specify a critical cue. This makes the critical cue easily accessible within the individual's memory. As a consequence, there is a high probability that the critical cue will be seized, whenever encountered again, as a good opportunity to act towards goal intentions. The second process implies to formulate one's intention according to the "if-then" model. This particular formulation connects the critical cue to the goal-directed behavior. The result is a behavior self-directed towards a particular cue, and this makes the goal-directed behavior to activate automatically whenever the critical cue is encountered. This means that the limited resources like memory, attention span, and self-control are no longer solicited to intervene over the intentions; the behavior is automatically-driven, without depletion of psychological resources (Gollwitzer, 1999; Parks-Stamm, Gollwitzer and Oettingen, 2007).

The present study

We believe it would be useful to test the effect of the context over the efficiency of the implementation intention-type intervention, in a situation that is as close as possible to day-to-day activity. This is why we are undertaking the development of a feasibility study meant to verify the effect of the context in which the "if-then" plan is formulated over the efficacy of the implementation intention. The question guiding our first study is: do the effects of ego-depletion and hopelessness in the moment of intention formation have an influence on the efficacy of the intervention (i.e. to increase fruit consumption)?

Ego-depletion role. Results have shown that the "if-then" plans were more efficient when cognitive resources were available (d=.85) (Gollwitzer and Sheeran, 2006). Whereas most previous research was done to see if this type of intervention is efficient in more specific areas of research, like changing eating behavior (Aadrianise et al. 2011), emotional regulation (Webb et al. 2012), increasing physical activity (Bélanger-Gravel et al. 2013), enhancing prospective memory (Chen et al. 2015), we believe that the context in which people formulate these plans has not been sufficiently investigated. For instance, students might wish to improve their learning process and establish a plan for implementation intention during their finals, when most of them are already in an ego-depleting situation. Another example is the case of people that wish to refrain from eating unhealthy food and establish an "if-then" plan to succeed this. Their plan is formulated to face a situation where they are craving, but the actual formulation of the "if-then" plan happens in a context where they are not exposed to cues that might engender cravings. It's important to know if the context or the moment when people are formulating their "if-then" plan has an effect on the efficacy of the implementation intention intervention.

Only one study has so far investigated the effects of context on the efficacy of implementation intention regarding performance in a task. Webb and Sheeran (2001) built an experiment to test this. They showed that participants that were ego-depleted during the first task, they had to accomplish and formulated a plan for implementation intention, performed better in a subsequent Stroop task compared to the participants that were not in an ego-depleted state when formulating their plan (Webb and Sheeran, 2001). The authors were surprised that the implementation intention strategy only enhanced the performance of the participants that were in an ego-depleted state (and not that of those that were not ego-depleted) (Webb and Sheeran, 2001). However, this single result is counter-intuitive, since being in an ego-depletion state also means having fewer resources to cope with various challenges an individual has to face. Therefore such a finding needs to be conceptually replicated.

Hopelessness role. To the best of our knowledge there are no past research to investigate the link between a hopelessness state and the effectiveness of if-than plans. However, by definition hopelessness refers to a loss in confidence that future events will be positive (Pan and Choiu, 2004). The concept shares with if-than plans a temporal orientation, by focusing on potential future events. But whereas if-then plans can be seen as problem-solving messages within the control of a person, hopelessness contains a giving up message, due to a perceived lack of control on events, and due to a deficit in energy and drive to reach a desired goal. Therefore, our research question would be to see how if-then plans are affected within a primed hopelessness context where they are learned.

Being a pilot study, we conducted this research in order to assess the feasibility of all three manipulating conditions - control, ego-depletion that involves a conceptual replication of Webb and Sheeran's (2001) endeavor, and hopelessness that involves an entire new procedure to prime a hopelessness state. We are also interested to see whether such if-than plans work across conditions, from pre- to posttest assessment. Last, but not the least, we are interested to see any descriptive moderating effect of learning context, although given the small sample size we do not expect such an interaction effect would be statistically significant.

Method

Participants

73 Psychology students (both from Bachelor and Master programs) that were interested in increasing their fruit intake participated in the study in exchange for course credit. The participants were randomized in one of the three experimental conditions: ego-depletion, control, hopelessness. The pretest results concerning fruit consumption within the 48 hours before participation showed that approximately half of the participants already eat more than three fruits within the last 48 hours before pretest. Hence we decided to exclude them from the analysis, because they would benefit less from implementing an implementation intention strategy as they are already eating at least two fruits / day as a minimum intake. The final sample was composed of 36 students that stated they had less than three pieces of fruits within the last 48 hours.

Procedure

The participants had to go through one training session, which lasted a total of 90 minutes. 48 and 96 hours after the experiment, participants were requested to answer the following questions by e-mail: (1) Did you eat any fruit in the last 48 hours? (2) If yes, please let us know what kind of fruit did you eat, and how many of each. This was the measure for fruit consumption, 48 hours and 96 hours after the experiment.

The experiment had three conditions: control (1), ego-depletion (2), hopelessness (3). The participants were randomized to one of the three arms. For step one of the process, each participant received an ID and consent form. All participants had to answer the following questions on a scale from 1 (hardly at all) to 5 (a lot): *Q2.1 Do you consider yourself to be interested in maintaining a healthy diet?, Q2.2 Do you consider it would be helpful if you would consume more fruit?, Q2.3 Do you consider it would be helpful to establish goals for eating fruit, specifying when will you do this?*.

For Q2.4, participants stated the frequency of fruit consumption in the prior week on a scale from 1 (never) to 5 (often, more than seven times). Last question (Q2.5.) was about fruit consumption in the two days prior the experiment. Participants answered with YES or NO. Participants that answered with YES were further asked what fruit did they eat, and how many of each fruit.

For the participants in the control condition, the next stage was to recall and describe what they did in the recent week off: November 30th– 5th of December. They received the following instruction: *"Next, please let us know extensively how you spent the week off between November 30 and December 5th, 2016. For this task, you will have 20 minutes. Please focus and write at least 30 lines about your experiences".*

The participants in the ego-depletion condition had a task similar to that of the control condition. The difference was that the participants in the ego-depletion condition were not allowed to use the letters "a" and "n" for writing their story. Instead, they had to use the characters "_" and "!". The participants in the ego-depletion group received the following instruction: *"Next, please let us know extensively how did you spent the week off between November 30 and December 5th, 2016. While you are writing, please pay a lot of attention and not use the letters "a" and "n". Instead of the letter "a", you will use the character "_" and instead of the letter "n" you will use the character "!" For this task, you will have 20 minutes. Please focus and write at least 30 lines about your experiences".*

According to a meta-analysis (Carter et al., 2015), this type of ego-depletive manipulation was previously used in 10 other studies and is known by the name of *the attentional essay.* For the purpose of the present study, the method was slightly changed in the sense that the participants were told what symbols to use instead of the two letters they were not allowed to, and this mention did not appear in the original manipulation. The purpose of this task was to determine an ego-depletion state.

The participants in the hopelessness group received the following instruction: *"Next, please recall and write about a situation when you felt discouraged and thought about giving everything up. A situation in which you thought that everything you did by then really did not matter. A situation in which you lacked the energy, self-efficacy, or a situation that you thought you cannot face. A situation in your life when what you wanted to do only depended on your input, and still, for various reasons, you failed, so maybe you thought it would be best to give up on your resolution. Please write extensively about that situation and about the feelings that you had at that particular moment (what where your thoughts, what feelings did you have, what did you do). For this task, you will have 20 minutes. Please focus and write at least 30 lines about your experience".*

We chose to induce a hopelessness state because we know that when we want to change certain behaviors and we can't do this, we feel incapable, loose trust in ourselves and feel disappointed (e.g. when somebody can't maintain its healthy weight).

After this stage, all the participants received a questionnaire meant to check if the manipulation was effective. The participants in the control condition and the ego-depletion condition answered two questions: *Q1.1 How difficult was the task of describing your vacation? (1- very difficult, 6 - very easy); Q1.2. How tired do you feel after describing in writing how you spent your vacation? (1 – Very tired, 5 – not tired at all).* The participants in the hopelessness condition had to answer the same questions, but with a slight adaptation to match the treatment received: *Q1.1 How difficult was the task of describing a personal situation when you felt hopelessness (1- very difficult, 6 - very easy); Q1.2 How tired do you feel after describing in writing about the personal situation when you felt hopelessness? (1 – very tired, 5 – not tired at all).* All the participants completed a Mood Introspection Scale (Mayer & Gaschke, 1988) that was slightly adapted to fit the present study.

After completing this stage, all the participants received a presentation of the way they can formulate "if-then" plans to enhance their fruit intake. First, they were briefed about the benefits of fruit consumption and afterward they learned why people sometimes fail to behave according to their intentions. Also, the participants were taught how to establish implementation intention for increasing fruit consumption. They were asked to think of a plan and write it down according to the model. After they had done this, their plans were verified, and participants received recommendations for improvement when necessary. After their plans had been verified, they were requested to repeat their plan at least three times, until they know it by heart. Finally, they were reminded that they will be requested to answer the following questions by e-mail, after 48 and 96 hours: *(1) Did you eat any fruit in the last 48 hours? (2) If*

you answered the first question with YES, please mention how many fruit did you have, and how many pieces each.

Results

Experimental manipulation

To verify if the experimental manipulation was effective, we compared each experimental group to the other two groups. The participants in the ego-depletion condition were compared to all the other participants (control and hopelessness) regarding the assessment they made of task difficulty and the level of tiredness they felt. The participants in the hopelessness condition were compared to all the other participants (control and ego-depletion) regarding the general level of hopelessness. Since there is a small number of participants for each condition, we considered that the non-parametric U Mann Whitney test is the most adequate to use for checking the effectiveness of the experimental manipulation.

Table 1 shows that the participants in the ego-depletion condition felt more tired than the participants in the other two conditions (control and hopelessness): U=441.5, p=.03. Also, they report an increased level of task difficulty: U=278.5, $p<.01$ than the participants in the other two conditions (control and hopelessness).

We compared the participants in the hopelessness condition and the participants in the other two experimental groups (control and ego-depletion). The results show that the participants in the hopelessness condition felt more hopeless, and had less hope compared to the other two groups (control and ego-depletion) U=378.5, p=.03.

The equivalence of the three experimental groups

We checked to see if the three groups are equivalent regarding: (1) the importance they place on a healthy diet, (2) eating more fruit, (3) establishing goals for eating more fruit, (4) the frequency of fruit consumption in the last week. According to the results in Table 2, we can see that there are no significant differences between the three experimental groups regarding the interest for a healthy diet (F (2, 33) =.107, p=.899), establishing goals for eating more fruit (F (2, 33) =.322, p =.727), and the frequency of fruit consumption in the prior week (F (2, 33) = .711, p = .499).

The only significant differences between the three groups is regarding variable 2 (F (2, 33) = 3.35, p = .047) (see Table 2), but this result can be also seen as a carryover effect of the hopelessness manipulation.

The main effect

According to the results in Table 3, the means and standard deviation show that the quantity of fruit consumption tends to increase from pretest to posttest (48 hours after the experiment). Also, the results report a decrease of the quantity of fruit consumption for all the experimental groups from first posttest (48 hours after the experiment) to the second posttest (96 hours after the experiment). We can see that the increase of the quantity of fruit consumption for the ego-depletion condition is low, while for the other two conditions (control and hopelessness) is higher. The quantity of fruit consumption for the ego-depletion group at 96 hours after the experiment seems to be lower than the quantity of fruit intake in the pretest. For the other two experimental groups (control and hopelessness) the quantity of fruit consumption at 96 hours after the experiment is higher than the quantity of fruit intake in the pretest.

To check if there are significant differences between the three experimental groups regarding the change in fruit consumption from pretest to posttest (48 and 96 hours past the experiment), we used the non-parametric comparison test Kruskal-Wallis. The results indicate that there are no significant differences between the two experimental conditions regarding the quantity of fruit intake, neither at posttest X^2 (2, N=36) = 3.72, p =.155, nor at the follow up: X^2 (2, N=36) = 3.54, p = .170, but in both cases the trend was in the expected direction (e.g. lower effect for implementation intentions that were acquired during an ego-depleted state).

Likewise, to check whether there is a significant main effect of implementation intention over fruit consumption, we used the non-parametric comparison test Friedman Test - X^2 (2, N=36) = 4.43, p =.109. This marginal result underlines a significant increase in fruit consumption between pretest and posttest – Wilcoxon Sign Test X^2 (1, N=36) = 2.75, p = .003, one-tailed test, a marginal significant increase in fruit consumption between pretest and follow up – Wilcoxon Sign Test X^2 (1, N=36) = 1.43, p = .076, one-tailed test, and lack of significant differences between posttest and follow-up – Wilcoxon Sign Test X^2 (1, N=36) = 1.14, p = .254, two-tailed test.

Table 1. Experimental manipulation. Comparison between each experimental group and the other two groups

Variables	*Ego-depletion (M Rank)*	*The other conditions (M Rank)*	*Statistical significance of the difference*
Tiredness	30.48	40.61	*U*=441.5, *p*=.03
Task difficulty	24.21	44.07	*U*=278.5, *p*<.01
N	26	47	
	Hopelessness	*The other conditions*	*Statistical significance of the difference*
Hopelessness	44.98	33.78	*U*=378.5, *p=.03*
N	21	52	

Table 2. The equivalence of the three experimental groups

Variables	*Control group M (SD)*	*Ego-depletion M (SD)*	*Hopelessness M (SD)*	*Statistical significance of the difference*
(1) *Do you consider yourself to be interested in maintaining a healthy diet?*	3.25 (.93)	3.10 (.56)	3.20 (.78)	F (2, 33) =.107, p = .899
(2) *Do you consider it would be helpful if you would consume more fruit?*	4.56 (.51)	4.70 (.48)	4.00 (.94)	F (2, 33) = 3.35, p = .047
(3) *Do you consider it would be helpful to establish goals for eating fruit, specifying when will you do this?*	3.31 (.79)	3.60 (.84)	3.40 (1.07)	F (2, 33) = .322, p =.727
(4) *Please note the frequency of fruit consumption in the last week*	2.68 (.94)	2.70 (.67)	2.80 (.90)	F (2, 33) = .711, p =.499

Table 3. Descriptive data at pretest, post-test (48h) and follow-up (96h)

Learning Condition	*Pretest M (SD)*	*Posttest M (SD)*	*Follow up M (SD)*
No of pieces			
Control / Standard (n = 16)	1.43 (1.31)	3.87 (4.14)	3.31 (3.99)
Ego-depletion (n = 10)	1.20 (0.92)	1.70 (2.21)	1.10 (1.28)
Hopelessness (n = 10)	1.90 (0.99)	3.90 (3.51)	4.30 (5.43)
Estimated weight (in grams)			
Control / Standard (n = 16)	219 (235)	615 (878)	439 (424)
Ego-depletion (n = 10)	190 (156)	317 (426)	146 (182)
Hopelessness (n = 10)	296 (172)	562 (564)	476 (496)
Estimated calories			
Control / Standard (n = 16)	151 (159)	333 (337)	255 (227)
Ego-depletion (n = 10)	111 (95)	214 (329)	91 (112)
Hopelessness (n = 10)	183 (92)	325 (326)	283 (285)
Eating fruits in the last 48 h	(frequency)		
Control / Standard (n = 16)	10/16	15/16	12/16
Ego-depletion (n = 10)	8/10	6/10	5/10
Hopelessness (n = 10)	9/10	9/10	8/10

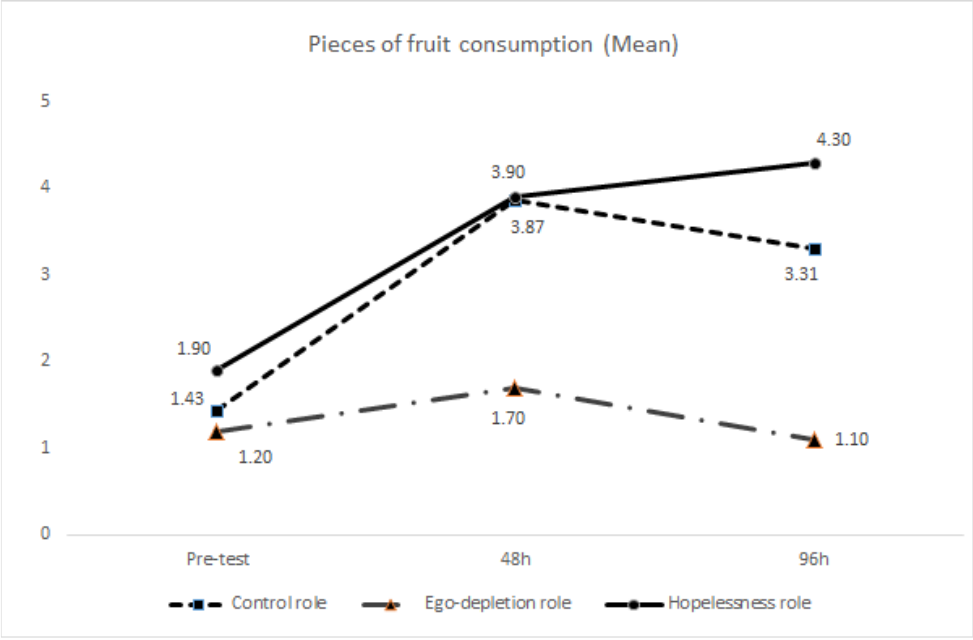

Figure 1. Illustrative picture for the evolution of fruit consumption (similar graphs are obtained for calories intake from fruits and for fruit quantity in grams, respectively)

Discussion

This study investigated if the learning context of implementation intentions has any influence over the efficacy of the intervention, i.e. an increase in fruit consumption. The results show that there are no significant differences between the three experimental conditions regarding the change in quantity or calories of consumed fruit. This means that for this study the context of learning implementation intentions (control, ego-depletion, and hopelessness) do not impact the efficacy of the intervention. However, due to lack of statistical power in testing the interaction effect, descriptive data suggest that learning implementation intentions in a particular condition (e.g. while ego-depleted) could impact the effectiveness of this behavioral strategy.

To the best of our knowledge, only one study has so far investigated the effects of context on the efficacy of implementation intention regarding performance in a task. Webb and Sheeran (2001) showed that participants that were ego-depleted during the first task they had to accomplish, and formulated a plan for implementation intention, performed better in subsequent Stroop task compared to the participants that were not in an ego-depleted state when formulating their plan. In their study, the implementation intention strategy only enhanced the performance of the participants that were in an ego-depleted state (and not that of those that were not ego-depleted) (Webb and Sheeran, 2003).

The ego-depleted state seems not only to influence the efficacy of an implementation intention strategy, but also seems to impact the duration of the intended behavior change (the amount of fruit consumption drops at posttest at the baseline level in the ego-depletion condition, whereas it remains close to the posttest level for the other two experimental conditions.

There are a few limits of the present study. First, we allowed people to participate in the study even if they stated that they had consumed 10, 20, 30 and even 60 pieces of fruit in the 48 hours before the experiment. Therefore our data are based on a post hoc decision to eliminate participants who do not fit to our expected profile (people who have difficulties eating enough fruits). We did not expect this to happen since the recruitment announcement specifically mentioned that the study is addressed to people that do not eat fruit and want to include more fruit in their diet. We believe that the motivation to participate in the study was more related to the extra credits they received for courses as a reward, rather than the wish to learn a behavioral self-regulation technique meant to help them eat more fruit.

Since this was a feasibility study, valuable lessons are to be considered. The manipulation check provides a successful discrimination among the three experimental conditions. However, whereas the distinction between ego-depletion condition and the control condition was excellent (all post hoc comparison being significant at ps < .001), there were less clear cut difference between the hopelessness group and the ego-depletion condition (both groups felt more tired after the manipulation task, but those in the ego-depletion condition also find the target task as more difficult). Likewise, post hoc comparisons solely based on the adapted version of Mood Introspection Scale failed to differentiate between the hopelessness condition and the control condition on key aspects (hopelessness level as a state), although the result was in the expected direction. More importantly, eligibility conditions for participants should be configured based on these pilot study findings. In future research, we intend to increase the number of participants in each experimental condition and only include in the experiment those participants that either do not consume fruit at all, or consume very little fruit (e.g. less than or up to two pieces of fruits per day), because we want to test the effectiveness of implementation intention strategy that was acquired on various learning contexts on target participants who otherwise face difficulties in their attempt to increase their fruit consumption.

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Positive Psychological Capital and Parenting Styles among adolescents: Khasi and Non-Khasi Scenario

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The psychological capital (PsyCap), an individual's positive psychological state of development, is characterized by four components. These four components are (1) Hope (commonly associated with one's positive expectancy towards the future, (2) Self-efficacy (confidence to put in considerable effort to succeed at challenging task), (3) Resilience (individual's capability to successfully cope with adverse circumstances, uncertainty and conflict and (4) Optimism (a cognitive process directed at positive outcomes or expectancies of a bright and prosperous future). The sample consists of 160 Khasi (75 boys and 85 girls selected from East Khasi Hills district of Meghalaya) and 185 non-Khasi (100 boys and 85 girls selected from Kolkata district of West Bengal) adolescents studying at high schools of East Khasi Hills district of Meghalaya and Kolkata district of West Bengal. Parental Authority Questionnaire and Psychological Capital Scale were used to assess the parenting style and positive PsyCap, respectively. The results revealed that dimensions of positive PsyCap vary with respect to culture and the effect of culture is prominent among adolescent boys. Non-Khasi adolescent boys are significantly higher on positive PsyCap dimensions than their Khasi counterparts. Adolescents who perceive their parents as high on authoritarian dimension display lower level of Positive PsyCap and its dimensions while those perceive their parents as high on authoritative style score higher on Positive PsyCap and its dimensions. Implications for parental practices and positive PsyCap in families and schools are discussed.

Keywords: Adolescents, Culture, Parenting style, Positive Psychological Capital.

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Introduction

The concept of positive psychology was introduced by Seligman (1998). Positive psychology assesses human beings' virtues, strengths and weaknesses in order to make them effective in a dynamic environment (Sheldon & King, 2001). From the concept of positive psychology, the notion of psychological capital (PsyCap) has been emerged. Positive PsyCap is an individual's state of advancement that gives rise to positive mental psychological state, which is beneficial at the time of crisis. Positive psychological assets such as hope, self-efficacy, resilience, and optimism (HERO) characterize PsyCap, an individual's positive psychological state.

Hope is the quality that motivates an individual to chase goals persistently and sometimes changing the pathways in order to reach goal successfully. Luthans, Avolio, and Walumba (2005) defined hope as the "perceived capability to derive pathways to desired goals and motivate oneself via agency thinking to use those pathways". Individuals with high levels of hope are motivated towards attaining goals and consequently display high levels of engagement. Self-efficacy, another crucial component of PsyCap, is defined as an individual's belief about whether or not he/she can accomplish a task. Ouweneel, Le Blanc, and Schaufeli (2012) observed that an individual's level of self-efficacy governs his/her effort when faced with unanticipated impediments. Resilience is an individual's ability to face adverse situations in life in order to adapt to negative events and uncertainties. Optimism is another important component of positive PsyCap. Tiger (1971) defined optimism as "a mood or attitude associated with an interpretation about the social or material – one which the evaluator regards as socially desirable to his [or her] advantage or for his [or her] pleasure". Optimistic persons expect positive outcomes in life and this positivity leads to success in most of the times.

The four psychological dimensions of positive PsyCap are necessary ingredient for a happy and meaningful life. Research has proved that most of the people especially

adolescents are becoming less happy and depression prone (Seligman, Ernst, Gillham, Reivich, & Linkins, 2009) in spite of being surrounded by ultimate comforts of life (Seligman, 1995). According to Seligman (1995), despite the new opportunities, the rates of hopelessness, depression, meaninglessness and passivity among people especially adolescents, are getting higher day by day (Seligman, 2002, 2006; Seligman et al., 2009) and these consequently impair the development of a society. Adolescents move from high school to greater world and encounter new and more challenging situations in different spheres of life. Developing Positive PsyCap will serve as protection against the potentially deleterious impact of negative environmental variables and consequently facilitate mental health.

Parenting style and its effect on overall development is a well-researched topic among researchers. Parenting style represents the strategies that parents use in their child rearing. Baumrind (1966, 1967, 1991) identified three basic styles of child rearing: authoritarian, permissive, and authoritative. The three parenting styles differ in two dimensions of parenting: the amount of warmth a child receives from parents and the extent to which a child's activities and behaviours are controlled by parents (Baumrind, 1991). Parents who display authoritarian style restrict the autonomy of children and expect children to follow their orders without asking any questions. Permissive parents encourage their children's autonomy and do not impose any authority on their children. Though permissive parents foster autonomy, their control over children's behaviour is very poor (Baumrind, 1991; Reitman, Rhode, Hupp, & Altobello, 2002). Authoritative parents tend to foster autonomy among children and employ moderate parental control. Children reared in this style are not completely restricted but have room for expressing their autonomy to certain extent and consequently, this parenting style enables children to make their own decisions and regulate their own activities (Baumrind, 1966, 1967, 1991; Reitman et al., 2002).

Researchers also showed parenting styles aim to shape and enhance children's positive PsyCap, competencies and overall development. Authoritarian parenting style has negative relationship with self-efficacy among adolescents (Tam, Chong, Kadirvelu & Khoo, 2012; Shaw, 2007; Dehyadegary, Nejad, Nasehzadeh & Divsalar, 2014; Yousaf, 2015), while self-efficacy has significant positive relation with authoritative/flexible parenting style (Tsemrekal, 2013; Chao, 2001; Yousaf, 2015) and permissive parenting style (Lopez, 2002; Anjum & Kausar, 2009; Yousaf, 2015). Griess (2010) suggested that the perceived authoritative parenting style contributed to higher levels of optimism than the authoritarian parenting style. Gota (2012) revealed that authoritative parenting style has positive impact on academic self-efficacy and achievement motivation among boys and girls compared to non-authoritative parents. Children of authoritative parents have high level of self-esteem and tend to be self-reliant, self-controlled, secure, and inquisitive than youth having authoritarian or permissive parents (Buri, Louiselle, Misukanis, & Mueller, 1988; Wenar, 1994). Gera and Kaur (2015) found insignificant correlation between Parenting style and Resilience. Zakeri, Jowkar and Razmjoee (2010) revealed a positive and significant correlation between acceptance-involvement parenting style and resilience. Warmth, supporting, and child-centred parenting style associated with the development of resilience. Ritter (2005) found that an authoritative parenting style is associated with high levels of resiliency while authoritarian and permissive parenting styles were most often associated with those participants with low resiliency. Parents are the primary teachers who inculcate the motivational thinking and encourage in finding out suitable route to achieve goals. Kumar, Sharma and Hooda (2012) revealed significant positive correlation between hope and three types of perceived parenting style i.e. democratic, accepting and overprotecting and negatively correlated with rejecting parenting style.

However, adopting different types of parenting styles in family is influenced by several factors and culture is one of them. Most of the times, children in Asian cultures, especially in India, imbibe values, customs and respect for others (mostly elderly people). Children are taught to obey decisions of elderly person and significant others in the family and society in order to get social approval in the form of external rewards rather than internalizing values into one's sense of self. Chaudhary (2004) argued that 'familism' is a significant reality for Indian families. Indian children live with their parent's identity whereas in the Western culture children are encouraged to have their own identity (Geertz, 1984). In India, children aged below 12 years expect to obey authority unquestioningly, adolescents aged between 12 to 14 years are given relatively more freedom but constantly supervised by family members (mostly elders in the family) and mature aged above 16 years are given freedom, while also being guided and somewhat controlled (Bisht, 2008). On the other hand, Western parenting styles provide enough freedom to behave without any pressure of complying with societal expectations and norms (Keller & Otto, 2009). Adolescents of European background in Canada reported their mothers as authoritative in nature whereas adolescents in India reported their mothers as authoritarian in nature (Garg et al., 2005). India, a land of unity in diversity is also influenced by the trend of globalization. It may be assumed that parenting style differ largely in matrilineal and patriarchal society because in matrilineal society, the descent or the family name is through the mother side, and is known as "matrilineal descent" (Kapadia, 1966). On the other hand, in a patriarchal structure, men are given considerable authority and are perceived as superior than women. Rai, Pandey & Kumar (2009) studied boys and girls from Khasi tribe of Meghalaya state. The results revealed that boys have significantly more rejection from father as compared to girls and girls have shown significantly better emotional warmth from father. Jambunathan and Counselman (2002) compared parenting style of Indian mothers living in India with Indian mothers living in the United States. The authors found that Indian mothers living in the U.S. were employing authoritative parenting, while the mothers living in India had a clear authoritarian parenting style. These results are important in highlighting the many ways in which culture influences our actions and determines who we are.

A closer inspection of the review of studies reveals that parenting rearing style has greatest influence on the development of child's positive PsyCap, self-esteem and self-reliance. In psychological literature, there are huge numbers of studies regarding relationship between parenting style and development of children. However, studies in North-East India, particularly on Khasi population, a matrilineal tribe of Meghalaya is few. Therefore, the present study explores the nature of perceived parenting style and positive PsyCap among Khasi and Non-Khasi adolescents.

The present study

In view of these objectives, the present study is to investigate:

- The perception of different dimensions of parenting styles (authoritarian, authoritative and permissive) by Khasi (belonging East Khasi Hills district of Meghalaya) and non-Khasi (belonging to Kolkata district of West Bengal) adolescents.

- The perception of different dimensions of Psychological Capital (Hope, Optimism, Self-efficacy and Resilience) by Khasi and non-Khasi adolescents.

- The relationship between perceived parenting style and psychological capital in Khasi and non-Khasi adolescents.

Method

Participants

The sample consists of 160 Khasi (75 boys and 85 girls) and 185 non-Khasi (100 boys and 85 girls) adolescents studying at high schools. Participants of the study were drawn from different schools of East Khasi Hills district of Meghalaya and Kolkata district of West Bengal. These districts were selected for convenience and the presence of capitals, thereby, inducing some variation in family background. Four schools (two co-educational, one boy's and one girl's) from each district were selected randomly from the lists taken from District Inspectors' (D.I) offices. Meghalaya is the homeland for three matrilineal tribes and one of them is Khasi. For a comparative study, a group of school students from West Bengal was also selected. The age ranged from 17 to 19 years with a mean age of 18.01 (Standard deviation – 4.02). A stratified random sampling method was used to divide students into two strata i.e. Khasi and non-Khasi. Simple random sampling without replacement (SRSWOR) method was used for selecting students from each stratum (Khasi and non-Khasi).

Measures

The following measures were used in this study:

Personal Data sheet: Certain personal information of students' such as age, gender and place to stay and schooling were collected using personal data sheet.

Psychological Capital (Luthans et al., 2007): Psychological capital scale was developed by Luthans, Youssef, and Avolio (2007). This scale analyzed four dimensions of Psychological Capital: hope, optimism, self-efficacy and resilience. The scale had 24 items i.e., 6 items of each dimension. This is a 7 point scale and scores on the scale varies from 1= strongly disagree to 7= strongly agree. The score for each dimension varies from 6-42. The higher score on each dimension indicates high on the respective dimensions. The Cronbach's alpha of four dimensions range from 0.70 to 0.73.

Parental Authority Questionnaire (PAQ): It was developed by Leman (2005) to measure the parenting style as perceived by adolescents. The scale was based on the scale developed by Buri (1991), which adopted three parenting styles of Baumrind (1966). The PAQ scale consists of 21 items. There are four response options for each question. The Cronbach's alphas for authoritarian, authoritative and permissive parenting style subscales for the present study were calculated and were found to be 0.70, 0.68 and 0.64 respectively.

Results

Preliminary analyses

Basic descriptive statistics for the main study variables were calculated. Additionally, we conducted two-way Analysis of Variance (ANOVA) to determine the effect of culture, gender and their interaction effect on positive PsyCap. The result indicates that significant effect of culture [$F(1, 341) = 8.34$, $p<0.01$] on overall positive PsyCap and its different dimensions. Closer inspection reveals that non-Khasi adolescents are significantly higher on overall Positive PsyCap [$t(343) = 4.30$, $p<0.0$] and its different dimensions [Hope: $t(343) = 3.85$, $p<0.01$, Self-efficacy: $t(343) = 3.72$, $p<0.01$, Resilience: $t(343) = 4.01$, $p<0.01$ and Optimism: $t(343) = 3.64$, $p<0.01$] than Khasi adolescents. ANOVA result reveals effect of gender on overall positive PsyCap and its different dimensions. Significant interaction effect of culture and gender [$F(1, 341) = 9.56$, $p<0.01$] on overall positive PsyCap and its different dimensions has been determined. Adolescent boys of non- Khasi community report significantly higher on Positive PsyCap [$t(173) = 6.39$, $p<0.0$] and its different dimensions [Hope: $t(173)=5.91$, $p<0.01$, Self-efficacy: $t(173)=4.92$, $p<0.01$, Resilience: $t(173)=5.03$, $p<0.01$ and Optimism: $t(173)=5.89$, $p<0.01$] than Khasi boys.

Two-way ANOVA was carried out to determine the effect of culture, gender and their interaction effect on the perceptions of different dimensions of parenting style. Main effect of culture $F(1, 341) = 8.23$, $p<0.01$and interaction effect of culture and gender $F(1, 341) = 11.01$, $p<0.01$was found to be significant. Closer scrutiny suggests that Khasi adolescents significantly higher on perceived parental control than their non-Khasi counterparts [$t(343) = 5.61$, $p<0.01$] whereas the opposite trend is evident in case of authoritative parenting style [$t(343) = 5.01$, $p<0.01$] and permissive parenting style [$t(343) = 4.13$, $p<0.01$]. Khasi boys reported significantly higher perceived parental control than non-Khasi [$t(173) = 4.81$, $p<0.01$] and non-Khasi boys reported significantly higher parental authoritativeness than their Khasi counterparts [$t(173) =3.12$, $p<0.01$].

Main analyses

Bivariate correlations were also conducted and the results are presented in Table 1. They indicate that for non-Khasi adolescents, perception of authoritarian parenting style is negatively and significantly associated with overall positive PsyCap and its dimensions whereas the reverse relationship is evident in case of authoritative parenting style. The positive association is seen between perception of permissive parenting style and positive PsyCap but none of the correlation index was found to be significant. For Khasi adolescents, perception of authoritarian style is negatively associated with positive PsyCap and its dimensions. None of the correlational value was significant. The positive and significant association is seen between perception of authoritative parenting style and overall positive PsyCap, hope and self-efficacy. Permissive parenting style is also positively associated with positive PsyCap and its dimensions but none of the values is significant.

Hierarchical regression analyses were conducted to assess the significant predictors of positive PsyCap and the results are displayed in Table 2. In each regression analysis, the statistical control variables (adolescent gender and parent gender) were entered in the first step, while the three parenting dimensions (authoritarian, authoritative and

permissive) were simultaneously entered as predictors in the second step. Regression analyses were conducted separately for non-Khasi and Khasi on each of the four dimensions of positive PsyCap.

Table 2 displays that in step 1, none of the predictors is found to be significant for both Khasi and non-Khasi adolescents. In step 2, perception of authoritarian dimension is negatively associated with overall positive PsyCap and its dimensions for non-Khasi adolescents only. Authoritative parenting style is positively and significantly associated with overall Positive PsyCap and its dimensions for non-Khasi adolescents whereas resilience and overall positive PsyCap are positively and significantly associated with perception of authoritative parenting style of Khasi adolescents.

Table 1. Bivariate correlations among main study variables

	Parenting style					
	Authoritarian		Authoritative		Permissive	
	Non-Khasi (N=185)	Khasi (N=160)	Non-Khasi (N=185)	Khasi (N=160)	Non-Khasi (N=185)	Khasi (N=160)
Overall Positive PsyCap	-0.24**	-0.11	0.32**	0.16*	0.13	0.08
Hope	-0.25**	-0.10	0.28**	0.17*	0.12	0.07
Self-efficacy	-0.27**	-0.09	0.31**	0.19*	0.11	0.09
Resilience	-0.22**	-0.11	0.29**	0.10	0.10	0.06
Optimism	-0.24**	-0.08	0.30**	0.09	0.14	0.11

Notes: *p<.05; **p<.01.

Table 2. Regression analyses of parenting style dimensions and positive PsyCap

	Dimensions of Positive PsyCap									
	Hope		Self-efficacy		Resilience		Optimism		Overall Positive PsyCap	
Step 1	Khasi	Non-Khasi	Khasi	Non-Khasi	Khasi	Non-Khasi	Khasi	Non-Khasi	Khasi	Non-Khasi
G	0.04	0.08	0.05	0.04	0.08	0.004	0.007	0.08	0.03	0.004
PG	0.09	0.10	0.007	0.08	0.003	0.06	-0.002	0.005	-0.007	0.08
R^2	0.04	0.03	0.06	0.07	0.03	0.02	0.06	0.01	0.07	0.05
Step 2										
G	0.09	0.07	0.04	0.05	0.003	0.05	0.04	0.002	0.06	0.07
PG	0.03	0.02	0.006	−0.03	0.03	0.05	0.06	0.03	0.02	0.04
AN	0.04	-0.25**	-0.09	-0.23**	0.10	−0.26**	-0.10	−0.30**	0.009	−0.39**
AV	0.07	0.27*	0.10	0.19*	0.18*	0.27**	0.12	0.29*	0.20**	0.29**
PM	0.07	0.04	0.06	0.009	0.07	0.10	−0.09	0.10	−0.09	0.07
R^2	0.07	0.17	0.05	0.20	0.15	0.23	0.1	0.27	0.14	0.29

Notes: *p<.05; **p<.01, G= Adolescent gender, PG=Parent gender, AN=Authoritarian, AV=Authoritative, PM=Permissive.

Discussion

The present study intends to explore the nature of perception of parenting style (authoritarian, authoritative and permissive) and dimensions of positive PsyCap of adolescents belonging to Khasi and non-Khasi community. The results reveal that dimensions of positive PsyCap vary with respect to culture. Non-Khasi adolescent boys are significantly higher on positive PsyCap dimensions than their Khasi counterparts. The possible explanation for this is that in patriarchal society, the social status of boys is much higher than boys of matrilineal society and consequently, non-Khasi adolescents develop more Positive PsyCap. Interestingly, the result displays no significant difference between non-Khasi adolescent boys and girls with respect to their Positive PsyCap. This may be due to the beginning of the LPG (liberalization, privatization and globalization) era, onset of modernization and gender equality among adolescents especially in metro cities.

Bivariate correlations reveal that non-Khasi adolescents who perceive their parents higher on authoritarian dimension score lower on Positive PsyCap and its dimensions while those perceive their parents as authoritative score higher on Positive PsyCap and its dimensions. The possible explanation is that authoritative parents exercise control over children in a warm and loving environment and encourage their children's competencies, qualities and thereby developing positive PsyCap among their children. On the other hand, authoritarian parents exercise strict disciplinary guidelines for their children and consequently, children get very less opportunity for developing self-efficacy, hope, self-confidence and emotional well-being. The lack of self-confidence, self-efficacy and hope also give birth to lower level of optimism and ability to fight back in a stressful situation.

Supportive yet disciplined home environments promote sense of independence and autonomy among adolescents and consequently, encouraging the positive PsyCap among adolescents. Always judging accomplishments of adolescents' in terms of 'absolute standard' and shaping behavior forcefully may lower the level of hope, optimism and self-efficacy.

Regression analyses reveal similar results of bivariate correlations. In the case of resilience and optimism, the perception of authoritative and permissive interacted such that the relation between permissive parenting style and positive PsyCap is dependent upon the level of perception of authoritative parenting style.

Conclusions

The present study explores the relationships between parenting style and positive PsyCap of Khasi and non-Khasi adolescents. The results revealed that dimensions of positive PsyCap vary with respect to culture and the effect of culture is prominent among adolescent boys. Non-Khasi adolescent boys are significantly higher on positive PsyCap dimensions than their Khasi counterparts. Non-Khasi adolescents who perceive their parents as high on authoritarian dimension display lower level of Positive PsyCap and its dimensions while those perceive their parents as high on authoritative score higher on Positive PsyCap and its dimensions. Interestingly, the study has also revealed that freedom is only effective in developing positive PsyCap among adolescents in the context of higher parental concern.

In spite of having interesting findings regarding the relation between parenting style and positive PsyCap, there are several drawbacks of the present study. First, the study is a cross-sectional in nature, thus drawing cause and effect relationship among variables is not possible. Longitudinal study would be an alternative to this. The second limitation is that responses are based on self-report. Future research should replicate this findings using different sources of data collection such as parental reports, teachers' reports etc. The third limitation of this study is relatively small sample. Further study based on large samples from different regions would be useful for generalization.

Despite several limitations, the findings of this study have a number of implications for developing positive PsyCap and providing socialization among adolescents. Parents and teachers need to adopt authoritative style, which develops positive PsyCap among adolescents. Too much of restriction on adolescents hampers the development of positive psychological assets among adolescents. Providing freedom to adolescents is also crucial but this can only be effective when adolescents feel that they are being valued by others. Parents and teachers need to play the role of friend, philosopher and guide to the younger generation especially to adolescents. Adolescents may be encouraged to set specific, challenging personal and academic goals and use means-end analysis (breaking down the ultimate goals down into sub-goals to make it more manageable) to celebrate small successes in order to develop hope and self-confidence. Proper and timely feedback may be given in order to increase the self-efficacy of. In school and college, interactive and activity-based small projects may also be given as a part of curriculum in order to develop resiliency, self-efficacy and optimism. At home, adolescents may be given some responsibility to carry out that eventually enhances self-efficacy, hope and optimism.

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