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Predictors of individual differences in emerging adult theory of mind

Suzanne L. K. Stewart

Senior Lecturer in Psychology

School of Psychology

University of Chester

Parkgate Road

Chester CH1 4BJ

United Kingdom

Tel.: +44 (0) 1244-511-680

Email: s.stewart@chester.ac.uk

(Corresponding author)

Julie A. Kirkham

School of Psychology

University of Chester

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Abstract

Little is known about what factors are associated with emerging adult theory of mind (ToM). We predicted that childhood fantasy play (CFP), need for cognition (NfC), and fiction reading would be positive predictors due to their deliberative, perspective-taking nature while engagement with media and technology would be a negative predictor due to increased interpersonal distance. The best-fit mixed logit model (*n* = 369) showed that CFP, texting frequency, and NfC were significant positive predictors while smartphone usage and preference for task switching were significant negative predictors. Email and phone call usage were contributing non-significant negative predictors. Our study extends previous findings regarding NfC, and highlights the importance of CFP engagement for ToM beyond immediate childhood. Future research should investigate how subtly different media (e.g., texting vs smartphone use) have differential predictive relationships with social cognition. Data and code are available at doi: 10.17605/OSF.IO/CBD9J.

Key words: Theory of mind; Fantasy play; Media; Need for cognition; Reading

Predictors of individual differences in emerging adult theory of mind

Theory of mind (ToM; a.k.a. mentalising) is the capacity to understand that others have mental states (e.g., intention, motivation, belief) which can drive behaviour (Premack & Woodruff, 1978). Development of higher-level ToM (e.g., decision-making based on others' perspectives; predicting behaviour in strategic situations) is documented by false belief understanding around age 3-4 (Wellman, Cross & Watson, 2001) into adolescence (e.g., understanding social stories / "faux pas," Dumontheil, Apperly, & Blakemore, 2010; Klindt, Devaine, & Daunizeau, 2017) and by variation in complex ToM skills in typically developed adults (Apperly et al., 2010; Keysar, Lin, & Barr, 2003), but there is comparatively little research within the transitional period of emerging adulthood (Giovagnoli, 2019; Karmakar & Dogra, 2019). This is despite evidence that emerging adult brains continue to develop (Bennet & Baird, 2006; Taber-Thomas & Perez-Edgar, 2015) and that some differences in ToM performance between younger and older adults have been documented (e.g., Happe, Winner & Brownell, 1998; Sullivan & Ruffman, 2004). Additionally, while there is limited knowledge concerning what individual differences coincide with variation in ToM, this shortfall is most pronounced for emerging adults compared to other populations (Giovagnoli, 2019). We addressed this gap by investigating factors associated with variations in ToM in children and adults but which have not been investigated fully in the emerging adult population; namely fiction reading, involvement in childhood fantasy play (CFP), need for cognition (NfC), and involvement with media and technology.

As a key aspect of ToM, simulating others' perspectives correlates with engagement in and enjoyment of fiction reading (Kidd & Castano, 2013). While single exposures to fiction reading apparently do not lead to ToM changes (Camerer et al., 2018; Panero et al., 2016;

cf. Kidd & Castano, 2013; Pino & Mazza, 2016), there is evidence that greater lifetime exposure correlates with better ToM (Kidd & Castano, 2013; Mar, Oatley, Hirsh, de la Paz, & Peterson, 2006; Mumper & Gerrig, 2017; Panero et al., 2016; Tamir, Bricker, Dodell-Feder, & Mitchell, 2016) as well as empathy (Mar, Oatley, & Peterson, 2009), particularly for those who are more emotionally transported by the story (Bal & Veltkamp, 2013). Imaging work suggests that listening to fiction is related to greater activation in mentalising areas in some people but not others (Nijhof & Willems, 2015), supporting the idea that exposure to fiction is linked to ToM variation, although causation and direction thereof is unclear (Panero et al., 2016).

Some developmental theorists have described adult fiction reading as analogous to CFP (Lillard, 2002, Walton, 1990). CFP involves the creation of imaginary worlds and entities where "as if" reasoning and the temporary suspension of reality necessitate the simulation and meta-representational understanding of others' minds as well as the comprehension of false belief (Dore & Lillard, 2015; Weisberg, 2015). Developmental studies have reported connections between greater involvement in CFP and more advanced ToM (e.g., Nielsen & Dissanayake, 2000; Suddendorf, Fletcher-Flinn, & Johnston, 1999; Taylor & Carlson, 1997) though the causal direction is unclear (Lillard et al., 2013). Adults who show more involvement in fantasy empathy (Lee, Guajardo, Short, & King, 2010) and acting (Goldstein, Wu & Winner, 2009) show some ToM advantages.

Fiction reading and engagement in CFP both involve internal motivations to engage in complex cognitive processes which provide affective satisfaction (Mumper & Gerrig, 2016; Lillard et al., 2013). Relatedly, NfC is a validated concept referring to individual differences in the enjoyment of thinking and a drive to understand the world through deliberate, conscious thought (Cacioppo & Petty, 1982; Cohen, Stotland, & Wolfe, 1955) by

seeking out information and intellectual engagement (Cacioppo, Petty, Feinstein, & Jarvis, 1996). Research examining NfC and ToM is limited but evidence from related constructs is instructive. Systematic thinking has been found to be predictive of ToM (Ma-Kellams & Lerner, 2016). NfC has been found to relate to understanding of indirect meanings in conversation (Holtgraves, 1997) and in written metaphors (Olkoniemi, Ranta, & Kaakinen, 2016), perspective-taking in adolescents (Vanwesenbeeck, Ponnet, & Walrave, 2017), and considering others in moral behaviour (Strobel, Grass, Pohling, & Strobel, 2017). Kidd, Ongis, and Castano (2016) suggest that NfC may partly explain the relationship between fiction reading and ToM. Kidd, Rogers, and Rogers (2010) also found that adults who retrospectively report high levels of CFP (creating imaginary companions) scored higher on measures of cognitive absorption and achievement.

While the above constructs may have a positive relationship with ToM, involvement with some forms of media and technology may have a negative relationship due to the lack of face-to-face interaction and reduced channels of information from which to understand others' mental states (Echterhoff, 2013). Young adults are one population where electronic and social media use is increasing (Cabral, 2011; Levine, Waite & Bowman, 2007). While social media may help individuals remain in virtual contact (Ryan & Xenos, 2011), greater and/or maladaptive use tends to coincide with poorer social adjustment (Bodroža & Jovanović, 2016; Raacke & Bonds-Raacke 2015). Electronic and social media use is also positively correlated with increased distractibility and less-focused attention (Levine et al., 2007, Boer, Stevens, Finkenauer & Van den Eijnden, 2019). Thus, the ability to infer mental states and intent in real-world, prolonged, face-to-face conversational exchanges may be affected by media use, which offers more immediate gratification through updated content, alerts and messages (Boer et al., 2019).

Attitudinal stances alongside frequency and intensity of media usage are important. Carpenter, Green, and LaFlam (2011) found that participants who welcomed others' perspectives used Facebook to enhance real-life interactions and activities while those who avoided others' perspectives tended to use Facebook for online-only and sexual/romantic relationships. Thus, evidence for the relationship between media and technology use and ToM tentatively suggests a negative relationship; however, it is possible that some media engender a positive relationship with ToM. To allow for this, we measured several forms of media and technology usage and attitudes and adopted a data-driven analysis.

As outlined, deliberate abstract reasoning and perspective-taking are inherent to ToM (Harris, 1992), fiction reading, CFP, and the enjoyment of effortful thinking (NfC). Therefore, these may function as positive predictors of ToM. Conversely, engagement with media and technology may reduce opportunities for sustained face-to-face interaction and promote more distracted, immediate-focused cognition. Thus, ToM may be negatively predicted by engagement with such activities. We made several predictions with varying degrees of confidence to account for variations in existing evidence (similar to scientific betting markets, Forsell et al., 2019). Specifically, we predicted that fiction reading, NfC, and CFP would positively predict ToM (with high confidence, low confidence, and high confidence respectively) while involvement with various media and technologies would, generally, negatively predict ToM performance (low confidence). Our design and analysis aimed to test these theoretically-grounded hypotheses in a data-driven way.

Methods

Participants

Participants were opportunity sampled from Psychology students at the University of Chester, UK. A power calculation suggested that with 14 predictors, at least 341 participants would be required for an effect size of $f^2 = 0.07$ at 90% power and $\alpha = .05$. Because emerging adult ToM is likely to be complex, we assumed small-medium effect sizes. We aimed to recruit approximately 10% extra in case of incomplete surveys, withdrawals, and participants outside the 18-29 age range. Initial responses numbered 431. We excluded individuals who submitted no data at all (n = 8) or for the outcome variable (n = 2); or whose age was younger than 18 (n = 1), older than 29 (n = 47), or missing (n = 4). No other exclusions (e.g., outliers) were made, leaving a final sample size of 369. The sample's demographic characteristics can be viewed in Table 1.

[TABLE 1 ABOUT HERE]

Measures

Table 2 displays example items from each measure.

[TABLE 2 ABOUT HERE]

The UK version (Masterson & Hayes, 2007) of the Author Recognition Test (ART; Acheson, Wells, & MacDonald, 2008; Stanovich & West, 1989) measures lifetime fiction reading through the proxy of correct identifications and rejections of 80 real and false author names. The total of true positives is recorded, with a penalty of -1 for each false positive. Thus, scores can range from -40 to 40.

The 18-item Need for Cognition Scale (Cacioppo, Petty, & Kao, 1984) measures the desire and tendency to engage in focused and prolonged cognitive tasks and thinking. Participants responded on a five-point Likert scale from "Strongly agree" to "Strongly

disagree" (e.g., Olkoniemi et al., 2016; Vanwesenbeeck et al., 2017). Total scores range from 18 to 90, with higher scores indicating greater NfC. The Cronbach's alpha here was 0.87.

The 11-item Retrospective Childhood Fantasy Play Scale (RCFPS; Kirkham, Lloyd, & Stockton, 2019) retrospectively measures the tendency to engage in fantasy play in childhood. Participants respond on a five-point Likert scale. Total scores range from 11 to 55, with higher scores indicating a greater predisposition towards CFP. The Cronbach's alpha here was 0.92.

Seven scales from the Media and Technology Usage and Attitudes Scale (MTUAS; Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013) measured the usage frequency of the following: Email, Texting, Phone, Smartphone, Social Media, Facebook Friends, and Online Friends. We also used four attitude scales: Positive Attitudes towards Technology, Anxiety about Being without Technology or Dependence on Technology, Negative Attitudes towards Technology, and Preference for Task Switching. The MTUAS is a comprehensive measure for distinguishing between different activities and technology platforms, allowing for measurement of the breadth and frequency of individuals' media and technology use (Rosen et al., 2013). The Cronbach's alphas (alongside the number of items per subscale) for our sample were as follows: Email = 0.80 (four items), Texting = 0.65 (three items), Phone = 0.57 (two items), Smartphone = 0.84 (nine items), Facebook Friends = 0.78 (two items), Online Friends = 0.47 (two items), Social Media = 0.88 (nine items), Positive Attitudes = 0.75 (six items), Anxiety = 0.80 (three items), Negative Attitudes = 0.72 (three items), and Task Switching = 0.87 (four items).

The 36-item Reading the Mind in the Eyes test (RMET; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) measures affective ToM, which is emotionally-based, implicit, and instinctive (in contrast to cognitive ToM, which involves effortful, explicit reasoning;

Shamay-Tsoory, Tomer, Berger, Goldsher, & Aharaon-Peretz, 2005). Participants respond to facial photographs cropped to display only the eye regions by identifying what mental state is being expressed from four choices (e.g., “playful,” “comforting,” “irritated,” or “bored”). Responses to individual items recorded as correct or incorrect were used here (when total scores are used, these can range from 0 to 36).

Procedure

Participants completed the survey online in the following order: demographic questions (age, gender, ethnicity, highest educational degree, students’ current level of study), MTUAS, RCFPS, ART, NfC Scale, RMET. Participants received four participation credits upon study completion. The study was approved by the University of Chester Department of Psychology Ethics Committee.

Analysis

No analyses were run until data collection finished. Missing data by individual predictor items appeared to be missing at random, and comprised between 0% and 1.42% for any given item. The *mice* (Multiple Imputation by Chained Equations) package (van Buuren & Groothuis-Oudshoorn, 2011) in R (R Core Team, 2018) was used for imputation on the fuller dataset (n = 423).

A series of mixed logit models (MLM), a type of generalised linear mixed model appropriate for binary outcome variables (Jaeger, 2008), were fitted to the data using the *glmer* function in the *lme4* package (Bates, Maechler, Bolker, & Walker, 2015) in R. The initial model included all 14 predictors, and individual RMET item responses were entered as the outcome variable, with a crossed random effects structure comprising random intercepts for participants and RMET items. Laplace approximation was used to estimate the fixed effects parameters for the outcome variable. We employed the *dropterm* function

from the *MASS* package (Venables & Ripley, 2002) with each model to systematically remove non-contributing predictor variables (i.e., backward elimination). We built each subsequent MLM excluding the predictor that the *dropterm* output indicated would improve the AIC value the best (i.e., whose exclusion would produce the lowest AIC value). For tied AIC improvements, we excluded the predictor with the highest *p* value. We stopped at the MLM with the lowest achieved AIC value [see Stewart, Wright, and Atherton (2019) for an example of a similar analysis strategy]. This analysis strategy represents a combination of theory-driven and data-driven approaches: the initial selection of possible predictors was made on theoretical bases as outlined above, and the final model was determined through a systematic statistical approach. The final model was evaluated using VIF values and a binned residual plot. Twelve participants did not have social media accounts; thus, their data were excluded where Social Media, Facebook Friends, and Online Friends were used. Open data and R code can be found at doi: 10.17605/OSF.IO/CBD9J.

Results

Pearson's correlations coefficients among the predictor variables are shown in Table 3. The outlined backward elimination analysis strategy was followed until the eighth model, whose model parameters can be seen in Table 4. It contained seven predictors which had positive or negative directional relationships with ToM performance. The significant positive predictors were Texting, NfC, and CFP, while the significant negative predictors were Smartphone and Task Switching. Email and Phone were retained as non-significant negative predictors (removing these worsened model fit). (Predictor variables excluded during the elimination process were Fiction Reading, Social Media, Facebook Friends, Online Friends, Positive Attitudes, Anxiety, and Negative Attitudes). The VIF values for the model ranged

from 1.026 to 1.817, indicating no problem with multicollinearity. The binned residual plot indicated a good fit of the model to the data. See Figure 1 for a visualisation of the odds ratios of the standardised beta values.

[TABLE 3 ABOUT HERE]

[TABLE 4 ABOUT HERE]

[FIGURE 1 ABOUT HERE]

The final model was a significantly better fit for the data than a null model comprising only the random effects (χ^2 (7) = 53.85, p = 2.514 x $10^{-9;}$; AIC final model = 13481 vs. AIC null model = 13520). BIC values from the final and null models were used to calculate a Bayes factor of 525.67, indicating very strong evidence in support of the final model (Raftery, 1995; Wagenmakers, 2007).

Discussion

We found that greater levels of CFP, Texting, and NfC and lower levels of Smartphone use and Task Switching predicted better ToM in emerging adults. Although non-significant, Email and Phone were also negative predictors. Seven predictors were eliminated: Fiction Reading, Social Media, Facebook Friends, Online Friends, Positive Attitudes, Anxiety, and Negative Attitudes.

Our finding that retrospective reports of engagement in CFP positively predict ToM performance is relatively novel due to a lack of published work utilising young adults (Derksen, Hunsche, Giroux, Connolly & Bernstein, 2018; Wellman, 2017). The effortful creation of alternative realities in CFP contrasts with the relatively more passive inference and interpretation involved in fiction reading. It is also more social, with children co-constructing play experiences and sharing them emotionally with others (Vygotksy, 1962;

1978), for example, in the creation of imaginary worlds (Taylor, Mottweiler, Aguiar, Naylor & Levernier, 2018). The creative, divergent thinking ability involved in CFP may also be important (Kirkham & Kidd, 2015; Mullineaux & Dilalla, 2009), potentially explaining the significant, positive involvement of NfC and significant, negative involvement of Task Switching. Derksen et al. (2018) suggest that changes in divergent thinking over the lifespan may account for the increase in ToM abilities during childhood and early adulthood, and the decrease in older adults. It is important to note that various subcomponents of CFP that develop in a hierarchical system (e.g., social interaction, role-play, meta-communication; Thompson & Goldstein, 2019) may hold different relationships with ToM development and require further study. Furthermore, as the RMET measures affective ToM (Oakley, Brewer, Bird & Catmur, 2016), our results are not generalizable to cognitive ToM. Finally, participants with higher levels of adult fantasy proneness may be more susceptible to the imagination inflation effect in reporting their childhood play experiences (e.g., Heaps & Nash, 1999; Merckelbach, 2004). This refers to the tendency for the process of imagining to increase confidence in the belief that a non-real event has occurred (Garry, Manning, Loftus & Sherman, 1996).

Based on limited existing evidence, we tentatively predicted that the MTUAS variables would be negative predictors, but our data-driven approach allowed for a variety of possible relationships. Interestingly, Smartphone use emerged as a significant negative predictor while Texting showed the opposite pattern. The MTUAS Smartphone items tap typically solo activities (e.g., using GPS, reading email, web browsing, listening to music, using apps), whereas texting represents reciprocal communication. The finding for texting complements one of Carpenter et al.'s (2011) results: usage of Facebook to augment real-life relationships (like texting) was related to acceptance of others' perspectives. We note

that Carpenter et al. investigated purpose, rather than frequency, of media usage, and did not measure ToM skill. Other MTUAS scales were negative predictors (Email, Phone), but these were non-significant. Although causality is unclear, our findings contribute greatly to the limited evidence in this area and are critical given the increasing importance and frequency of media and technology involvement for emerging adults.

As noted earlier, previous evidence relating to many of our predictors is limited, particularly for media usage. Although our hypotheses were theoretically derived, we adopted a data-driven analysis strategy for a hybrid, confirmatory-and-exploratory approach. While our research has uncovered a variety of intriguing and useful findings, our predictions were "low confidence" for the media variables and NfC; hence, readers should view these particular findings as a preliminary first step towards more confirmatory research. Greater previous evidence existed for the relationship between ToM and CFP, which we predicted with "high confidence," and which emerged as an important predictor.

As with any work that examines individual differences with respect to a sophisticated ability like ToM, our chosen predictors represent a deliberately constrained focus. There are likely to be many constructs associated with emerging adult ToM. Despite this, our work gives direction for future research, in that CFP seems key, as does engagement with some forms of media and technology. There is scope for further investigation of how usage of subtly different media relates to ToM. The variety of media (e.g., social media; texting) and different platforms (e.g., Facebook; Instagram) mean that individual effects on ToM may be complex and dependent upon these, as well as upon frequency and purpose of usage. Thus, our study represents an important development but is limited by its broad-based approach.

Understanding why emerging adults vary in their ToM skill through investigating contributory individual differences will help researchers better understand the nature of

social interactions, relationships, and individuals' social adeptness. Our work suggests that an explanation begins in childhood from involvement in fantasy play to current involvement with some media and technologies alongside a tendency for sustained engagement as demonstrated by greater NfC and lower Task Switching. These findings add much-needed insight to the literature in suggesting what abilities and experiences coincide with emerging adult ToM, a social cognitive ability critical to interactions and relationships, and, therefore, what constructs should be examined further. In particular, people’s opportunities (or lack thereof) for sustained and deep engagement in perspective-taking may be key.

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Table 1

Demographic characteristics of the sample (n = 369)

Mean age (SD)	20.02 (2.23)
Gender (% Female) [six missing]	66.12%
Ethnicity [four missing]	
% White British	89.70%
% Black and Minority Ethnicity	9.21%
Current student level [ten missing]	
Undergraduate	92.41%
PG Certificate or PG Diploma	0.27%
Master's	3.25%
Doctorate	1.36%

Table 2

Example items for each predictor variable

Predictor variable	Example item(s)
Fiction Reading	"Emily Wolfe" (false); "Margaret Atwood" (true)
Need for Cognition	The notion of thinking abstractly is appealing to me
Childhood Fantasy Play	I often treated my toys as if they were real
Email	How often do you send, receive and read e-mails (not including spam or junk mail)?
Texting	How often do you send and receive text messages on a mobile phone?
Phone	How often do you make and receive mobile phone calls?
Smartphone	How often do you use apps (for any purpose) on a mobile phone?
Social Media	How often do you check your Facebook page or other social networks?
Facebook Friends	How many friends do you have on Facebook?
Online Friends	How many people have you met online that you have never met in person?
Positive Attitudes	I feel that I get more accomplished because of technology.
Anxiety	I get anxious when I don't have the Internet available to me.
Negative Attitudes	New technology makes people more isolated.
Task Switching	When doing a number of assignments, I like to switch back and forth between them rather than do one at a time.

Table 3

Pearson's correlation coefficients among the predictor variables †

	Texting	Phone	Smartphone	Social Media	Facebook Friends	Online Friends	Positive Attitudes	Anxiety	Negative Attitudes	Task Switching	Need for Cognition	Fantasy Play	ART‡
Email	.177	.337	.318	.180	-.087	-.013	.179	-.008	-.081	.159	.137	-.100	-.065
Texting		.387	.579	.422	.162	-.012	.130	.201	-.003	.013	-.202	-.040	-.045
Phone			.377	.341	.129	.010	.065	.059	-.076	.041	.029	-.071	-.032
Smartphone				.493	.038	-.002	.182	.060	-.039	.107	.079	-.115	-.021
Social Media					.191	.147	.204	.153	-.017	.121	-.161	-.001	-.095
Facebook Friends						.167	-.010	-.067	-.031	-.090	-.072	-.056	-.070
Online Friends							.032	.064	.055	.050	-.069	.033	-.015
Positive Attitudes								.312	-.189	.059	-.011	-.021	-.044
Anxiety									-.060	.072	-.231	.123	-.029
Negative Attitudes										-.017	.013	-.005	-.028
Task Switching											.060	-.073	.029
Need for Cognition												-.101	.112
Fantasy Play													.004

† *p*-values are not reported in this table as we were interested in examining the strength of the relationships and not hypothesis testing;

‡ ART = Author Recognition Test

Table 4

Parameters for the final model (n = 369)

	Estimate	Standard error	*z* value	*p* value	95% confidence interval
Intercept	1.24	0.13	9.28	$< 2 \times 10^{-16}$	0.97 to 1.51
Email	-0.06	0.04	-1.50	.134	-0.14 to 0.02
Texting	0.13	0.05	2.79	.005	0.04 to 0.23
Phone	-0.07	0.04	-1.63	.103	-0.15 to 0.01
Smartphone	-0.13	0.05	-2.76	.006	-0.22 to -0.04
Task Switching	-0.08	0.04	-2.33	.020	-0.15 to -0.01
Need for Cognition	0.07	0.04	1.98	.047	0.0006 to 0.15
Fantasy Play	0.18	0.04	4.93	8.43×10^{-7}	0.11 to 0.25

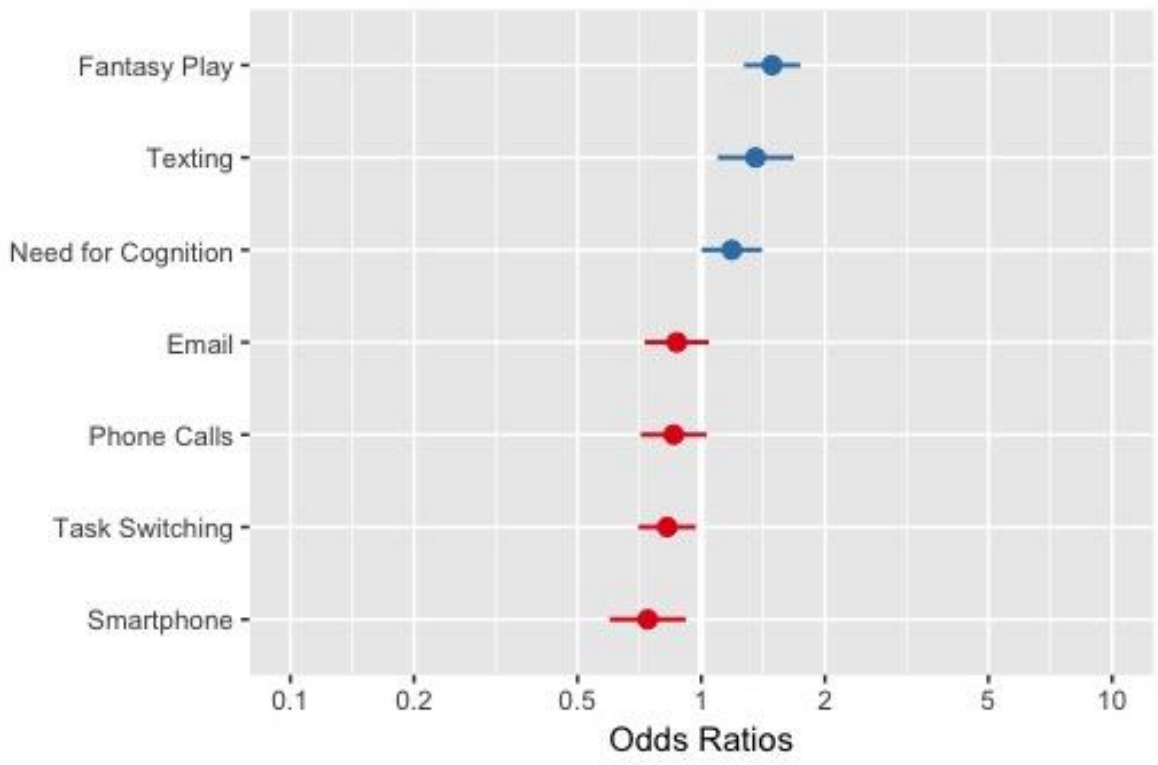

Figure 1

Odds ratios of the standardised beta values