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Associations between Fiction Reading, Trait Empathy and Theory of Mind Ability

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ABSTRACT

Several studies suggest a link between fiction reading and Theory of Mind, a component of cognitive empathy which refers to the ability to understand other people's mental and affective states. More frequent fiction readers perform better in tasks that require inference of intentions or emotions in others, like the Reading the Mind in the Eyes task. In addition, subjects who read a fiction text obtain better scores than controls reading non-fiction. Since most of this research has been conducted on caucasian subjects, cross-cultural replication of the effect is still needed. The present study is the first to investigate the subject in a Latin American sample (208 adults -137 females-, ranging from 18 to 59 years old ($M = 27.66$)). We replicated the association between lifelong exposure to print fiction and performance in the Reading the Mind in the eyes task, but the effect was only significant in men. The association remained significant after controlling for age, education level and self-reported Trait Empathy scores. The results are congruent with the hypothesis that reading promotes Theory of Mind ability by engaging mentalizing processes in order to represent the thoughts and feelings of fictional characters. The sex difference we observed had not been reported before and requires further replication and analysis.

Key words: fiction reading, cognitive empathy, affective empathy, Theory of Mind.

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Novelty and Significance

What is already known about the topic?

- Fiction reading is associated with better performance in tasks that require inference of emotions and mental states in others (Theory of Mind).
- Fiction reading might promote Theory of Mind by engaging mentalizing processes to understand the fictional characters thoughts and feelings.
- This effect has been shown to be independent of age, intelligence and personality measures.

What this paper adds?

- The association between fiction reading and theory of mind ability was replicated in a Latin American sample for the first time.
- The effect was only significant in men, a sex difference that has not been reported before in the literature.

Human empathy can be defined as the ability to understand other people's thoughts, intentions and feelings, a process that is accomplished by adopting the other person perspective in a given situation (Filipetti, López & Richaud, 2012). Recent models of empathy (Decety & Jackson, 2004; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009; Smith, 2006; Zaki & Ochsner, 2012) describe it as a multidimensional construct

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that integrated: 1) automatic affective experience of observed emotional states and 2) understanding of other's thoughts and feelings through controlled cognitive processes (Filipetti, López, & Richaud, 2012). Therefore, most current theoretical models distinguish two different aspects of empathy: cognitive empathy, the ability to infer, represent and comprehend beliefs, intentions, feelings and emotions in others, and to differentiate them from our own and affective empathy, the ability to experience affective reactions to the observed experiences of others (Davis, 1994; Dvash & Shamy-Tsoory, 2014). The crucial distinction between both aspects in relation to feelings and emotions is that *cognitive empathy* involves the representation of the affective state from another person's perspective, while *affective empathy* requires experiencing and appropriating these feelings, at least on a gross level (Dvash & Shamsay-Tsoory, 2014).

The cognitive component of empathy is often considered as equivalent to another theoretical construct, *Theory of Mind* (Baron-Cohen, Leslie, & Firth, 1985; Premack & Woodruff, 1978; Wellman, Cross, & Watson, 2001), which has been defined as the ability to attribute mental states to oneself and others, and to understand their difference as well (Premack & Woodruff, 1978). While some investigators consider Theory of Mind as a crucial component of cognitive empathy (Decety & Jackson, 2004), others use both terms as interchangeable (Blair, 2005; Smith, 2009). Furthermore, based on dissociations observed in neuroimaging studies, Dvash and Shamsay-Tsoory (2014) have differentiated between *cognitive Theory of Mind* (inference and understanding of thoughts) and *affective Theory of Mind* (inference and understanding of emotions), while both are considered as components of cognitive empathy.

Theory of Mind is usually assessed through experimental tasks, such as the "False Belief" tasks (Baron-Cohen, Leslie, & Firth, 1985; Wimmer & Perner, 1983), where the subject must take into account the beliefs of fictional characters in specific situations to respond accurately, or the "Reading the Mind in the Eyes task" (RMET) (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), where the subject is required to infer a person's feelings or emotional states from a picture that only displays the target's gaze. In both tasks, the subject's Theory of Mind ability is estimated by his accuracy. On the other hand, dispositional or trait empathy can be assessed through self-report measures, the most common among them being the Davis Interpersonal Reactivity Scale (IRI) (Davis, 1983) and the Empathy Quotient (Baron-Cohen & Wheelwright, 2004). Both questionnaires include subscales for cognitive and affective aspects of empathy. It should be noted that there is little evidence to support the compatibility or exchangeability of behavioral tasks and self-report measures of cognitive empathy, as their results are usually non-correlated or weakly correlated (Spreng, McKinnon, Mar & Levine, 2009; Melchers, Montag, Markett, & Reuter, 2015).

A growing body of evidence indicates that there is a relation between fiction reading and the cognitive aspect of empathy. A series of correlational studies showed that print-exposure to literary fiction is significantly associated to performance in a Theory of Mind ability task, the RMET (Fong, Mullin & Mar, 2013; Mar, Oatley, Hirsh, de la Paz, & Peterson, 2006; Mar, Oatley, & Peterson, 2009). Thus, subjects with greater exposure to fiction reading exhibited higher RMET scores, and this effect was: specific to fiction vs non-fiction reading (Mar *et alii*, 2006), and even fiction genre-specific (Fong *et alii*, 2013), independent of intelligence and personality measures (Mar *et alii*, 2009) and present in children too (Mar, Tackett & Moore, 2010). All these studies employed an indirect but objective measure of lifelong exposure to fiction (and non-fiction) texts: the Author Recognition Test (Stanovich & West, 1989). While this association might be

interpreted as a predilection for fiction narratives exhibited by more empathic subjects, other studies suggest that there might be a causal link between frequent fiction reading and cognitive empathy enhancement. In these studies, subjects exposed to literary fiction excerpts (Kid & Castano, 2013), short stories (Black & Barnes, 2015) or entire novels (Pino & Maza, 2016) performed better than controls (exposed to non-fiction) in the RMET task. Since literary fiction requires the reader to represent and understand the characters feelings and mental states, it has been hypothesized that fiction reading promotes Theory of Mind ability by engaging and stimulating mentalizing processes (Mar *et alii*, 2006, 2009). Furthermore, this effect has been shown to be stronger for character-driven narratives, like romance stories (Fong *et alii*, 2013) and in high-quality literary fiction (Kid & Castano, 2013), which was considered to be more demanding and challenging for mentalizing processes.

Despite the available evidence of the link between fiction and Theory of Mind ability, most of the studies have been conducted on caucasian populations (particularly within the United States), with the exception of Pino & Mazza (2016) (who studied an Italian sample). Therefore, cross-cultural replication studies of the effect are still required. In addition, few studies have jointly analyzed the association between reading, self-report measures of trait empathy and Theory of Mind Ability. In those studies where the Davis IRI is considered, only one or two subscales are included (except, in Mar, 2006). Consequently, the main goal of the present study was to replicate the previously observed link between fiction reading and Theory of Mind ability in a Latin American sample, analyzing the potential associations between: An objective measure of fiction print exposure (ART) and self-reports of reading habits as well, a self-report measure of cognitive and affective trait empathy (all four IRI subscales) and a behavioral measure of Theory of Mind ability (RMET). In addition, and following the recommendations of a recent study (Olderbak, Wilhelm, Olaru, Geiger, Brenneman, & Roberts, 2015), we applied a shorter version of RMET that was shown to have better psychometric properties and higher correlation with self-reported cognitive empathy than the original.

METHOD

Participants

Our sample consisted of 208 adults (137 females), ranging in age from 18 to 59 years ($M = 27.66$). Most of participants had completed university or were undergraduate students (90.3 %), while a minority (1.9%) had completed primary school only. The rest of participants had completed secondary school. All participants were Spanish native speakers living in Argentina at the time of the study.

Instruments

Ad hoc Reading Habits Questionnaire. Participants completed an Ad hoc Questionnaire about their reading habits. The first question was: "when did you start reading as a recreational activity"? (1: Pre-school "my parents read to me frequently"; 2, Primary school; 3: Secondary school; 4, University; 5, "I do not read in my free time"). The second item asked the subject to estimate the average hours per week they spent reading the following text materials: Academic/professional (reading for work or study), newspapers, magazines, e-mail, web sites (including social networks), fiction and non-fiction, rating their answers in a 7-point likert scale (from 0 to 7 or more hours per week).

Author Recognition Test (ART). The ART was developed by Stanovich & West (1989) to avoid the issue of social-desirability in the assessment of reading habits. This measure asks the subject to check off, from a list of names, those who they recognize as authors (even if they never read their works). Guessing is discouraged by including foils (false author names), and subtracting one point for each false author checked by the subject from the final score. Although it is not a direct measure of people reading habits, it constitutes an adequate index of exposure to print, since people tends to learn about authors as they participate in reading-related activities. The ART has been extensively validated, and it has been shown to predict actual reading behaviour (Stanovich & Cunningham, 1993; West, Stanovich, & Mitchell, 1993), as well as several reading and linguistic abilities (for a review, see Mol & Gus, 2011). A recent study showed that ART scores predicted fiction book online shopping intentions, an ecologically valid estimate of real world reading-related behaviour (Rain & Mar, 2014). Furthermore, ART has been used as an index of print exposure in all previous studies of fiction reading and empathy (Mar *et alii*, 2006, 2009; Kid & Castano, 2013, etc.). Since no version of the ART was available for Latin American populations at the time of the study, we developed our own, which consisted of 18 fiction writer names and 18 foils. The Real authors list included Literature Nobel prize winners (like Albert Camus, Haruki Murakami or Mario Vargas Llosa), recognized international English authors (like Ray Bradbury, Paul Auster or George Orwell), Spanish authors (Miguel Hernández, Arturo Pérez Reverte) and award winning or recognized (classic or contemporary) local authors (like Alejandra Pizarnik, Mario Benedetti or Manuel Puig). The 18 “fake” author names were selected from the editorial boards of several scientific journals. A complete list of ART author names can be found in Appendix.

Reading the Mind in the Eyes Task (RMET). The RMET was developed by Baron-Cohen, Wheelwright, Hill, Raste, and Plumb (2001) as a measurement tool to detect subtle cognitive dysfunctions in Theory of Mind abilities. The premise of the test is that Theory of Mind relies heavily on the perception of gaze in others. Therefore, the original task includes 36 items where participants view a photo of a person’s eyes and must decide which of four alternative terms describes their feelings and mental state best. While it was originally intended for clinical populations (particularly, Asperger syndrome and High functioning autism), it has been widely applied to research with healthy adults. The RMET has been translated to a variety of languages, including Spanish (Fernández Abascal *et alii*, 2013), and has been adapted to Argentina (Serrano & Allegri, 2006; Román, Rojas, Román, Iturry, Blanco, Leis, Bartoloni, & Allegri, 2012). A recent study (Olderbak *et alii*, 2015) developed a short 10-item form of RMET that showed better internal consistency and was more correlated to cognitive empathy measures than the original version. According to the study recommendations, we selected the following 10 items from the argentine adaptation and applied this short form to our subjects: 8, 9, 12, 15, 16, 19, 22, 24, 32, and 36. Each picture was shown in an individual screen, along with four possible descriptions of the person’s mental and emotional state. A glossary of each of these terms was also included, in order to control for the participant’s potential lack of knowledge of their definition.

Davis Interpersonal Reactivity Index Scale (IRI). The IRI Scale (Davis, 1980, 1983) is one of the most widely used self-report questionnaires to assess empathy, and is also one of the first multidimensional measures in the field (Melchers, Montag, Markett, & Reuter; 2014). It contains four subscales that evaluate cognitive (*Perspective Taking* and *Fantasy*) and emotional (*Empathic Concern* and *Personal Distress*) aspects of empathy. *Perspective Taking* subscale refers to the ability to understand the point of view of others, *Fantasy* refers to the tendency to identify oneself and get involved with fictional characters (from literature, movies, etc.). *Empathic Concern* refers to the feelings of compassion, sympathy and care elicited by others and, *Personal Distress* refers to feelings of anxiety and discomfort in response to other people’s negative experiences. The IRI has been adapted to Spanish language and validated in a sample of Spanish adults (Pérez Albéniz, de Paúl, Etxeberria, Montes, & Torres, 2003), as well as in a sample of argentinian children (Richaud de Minzi, 2008). Internal consistency indexes obtained in the Spanish adaptation were adequate and similar to those reported by Davis (1980), which ranged from α .70 to .78.

Procedure

Participants were contacted through the Facebook social network and invited to take part in the study. They were explained that the only requisites to participate were: to be older than 18 years old, to speak Spanish as a native language and to be living in Argentina at the time of the study. They were told that participation was voluntary and that they would not receive any kind of monetary compensation. They were also explained that their participation was anonymous; therefore, we would not collect any data that might allow identifying them. Finally they were explained that the study was part of an investigation carried out by psychology researchers from the *Pontificia Universidad Católica de Argentina*. If the participants agreed to the terms of the study, they moved on to a short demographic survey and then completed each of the sections in the following order: ad hoc reading habits questionnaire, RMET, IRI, ART. All data were collected through the *PsyToolkit* online platform (Stoet, 2010, 2017).

A similar study on empathy and fiction exposure (Fong, Mullin, & Mar, 2013) also employed an online survey to collect data from ART, RMET task and a personality questionnaire, and previous research suggests that online recruitment and testing can be equivalent to in-person data collection (Casler, Bickel, & Hackett, 2013).

Data analysis

Ad hoc questionnaire responses were treated as ordinal variables, while ART, RMET and IRI scores were considered continuous variables. For those correlational and inferential analyses that included the ordinal variables, we applied non-parametric statistics: Spearman's *Rho* coefficients and Mann-Whitney's *U*, respectively. In order to analyze the specific contribution of ART scores to RMET performance, we conducted a hierarchical linear regression with age, sex, education level and IRI scores as control variables (this procedure was similar to Mar *et alii*, 2009, 2010).

RESULTS

A detailed summary of recreational reading start, average hours of reading per week, ART, RMET and IRI results can be found in Table 1. Internal consistency of our ART version was high for real (Cronbach's $\alpha = .880$) and false (Cronbach's $\alpha = .812$) authors, and similar to that reported in Mar *et alii*. (2009). Accuracy in the RMET was $75.96 \pm 14.87\%$, and the participants discriminated correctly 25.87 ± 6.57 from a total of 36 (both real and false) author names (71.86%) in the ART.

We compared men ($n = 71$) and women ($n = 137$) reading habits, ART, RMET and IRI scores. Both groups were similar in age ($T_{206} = -0.375, p = .708$) and education level ($\chi^2 = 2.489, p = .647$). Men reported a later start of recreational reading ($U = 3.781, p = .003$), higher estimates of newspaper reading hours per week ($U = 3798.5, p = .004$) and lower fiction reading times ($U = 3843.5, p = .012$), while no differences were found on ART scores. Regarding Theory of Mind and trait empathy, both groups performed comparably on RMET, but men obtained lower fantasy ($T_{206} = 2.313, p = .022$) and empathic concern ($T_{206} = -4.489, p = .001$) IRI scores. These results are detailed in Table 1.

Spearman's rho correlation coefficients were calculated in order to analyze the associations between reading habits, IRI and RMET scores. Table 2. shows rho values for the full sample, men only and women only. Considering the full sample, significant associations were found between RMET performance and: ART score ($Rho = 0.151, p =$

Table 1. Average reading times per week.

Variable	Full sample (<i>N</i> = 208)	Men (<i>n</i> = 71)	Women (<i>n</i> = 137)	Statistics	
				<i>U</i>	<i>p</i>
Recreational Reading start	Kinder: 1.9%	Kinder: 1.4%	Kinder: 2.2%	3798.5	.004**
	PS: 57.2%	PS: 46.5%	P.S.: 62.8%		
	SS: 13.5%	SS: 11.3%	S.S.: 14.6%		
	Univ: 19.2%	Univ.: 25.5%	Univ.: 16.1 %		
	NRR: 8.2%	NRR: 15.5%	NRR: 4.4%		
Medians (interquartile ranges)					
Reading academic	5 (4.75)	5 (5)	5 (4)	4714	.707
Reading magazines	1 (2)	0 (2)	1 (2)	4548.5	.418
Reading newspapers	1 (2)	2 (2)	1 (2)	3798.5	.007**
Reading e-mail	2 (2)	1 (2)	2 (3)	4571	.913
Reading web sites	5 (4)	5 (4)	5 (4)	4819.5	.457
Reading fiction	4 (4)	3 (4)	4 (5)	3843.5	.012*
Reading non-fiction	2 (3)	2 (3)	1 (2)	4223.5	.057
	<i>M (SD)</i>			<i>T</i>	<i>p</i>
ART	25.87 (6.57)	26.83 ± 6.51	25.38 ± 6.57	1.507	.133
RMET	75.96 (14.87)	74.22 ± 16.18	76.86 ± 14.12	-1.213	.226
IRI-F	24.09 (5.58)	22.85 ± 5.31	24.73 ± 5.64	-2.313	.022*
IRI-PT	24.75 (4.8)	24.26 ± 5.35	25.07 ± 4.49	-1.053	.294
IRI-EC	29.73 ± 4.55	27.84 ± 4.81	30.71 ± 4.11	-4.489	<.001**
IRI-PD	15.48 ± 4.80	14.73 ± 5.05	15.87 ± 4.64	-1.624	.106

Notes: ART= Author Recognition Test; IRI-F= Fantasy; IRI-EC= Empathic Concern; IRI-PD= Personal Distress; IRI-PT= Perspective Taking; Kinder= Pre-school education; NRR= No Recreational Reading; * = $p < .05$; ** = $p < .01$; PS= Primary School; RMET= Reading the Mind in the Eyes Task; SS= Secondary School; Univ= University level.

.03), education level ($Rho = 0.187, p = .007$) and personal distress ($Rho = 0.169, p = .015$). Regarding trait empathy, fantasy scores were higher in those subjects who reported more frequent fiction reading times ($Rho = 0.363, p < .001$) and began recreational reading earlier ($Rho = -0.171, p = .014$), but tended to decrease with age ($Rho = -0.253, p < .001$).

RMET performance was significantly associated to ART scores within the men group ($Rho = 0.335, p = .004$), but this effect was not observed in women. In addition, RMET performance was better in those men with higher empathic concern scores ($Rho = 0.268, p = .034$) and in those who spent more time reading in web sites ($Rho = 0.252, p = .034$). On the other hand, Theory of Mind scores increased with education level ($Rho = 0.244, p = 0.004$) and (surprisingly) decreased with fiction reading times ($Rho = -0.183, p = .032$) in women. Subjects who reported more frequent fiction reading obtained higher IRI fantasy scores among men ($Rho = 0.378, p = .001$) and women ($Rho = 0.302, p < .001$) as well. All correlations are detailed in Table 2.

In order to analyze the specific contribution of fiction exposure to Theory of Mind, we conducted a hierarchical linear regression on RMET scores. The following control variables were introduced in the first block: age, sex, education level, and IRI subscale scores. Considering that the effects of fiction print-exposure on RMET differed between sexes, we included ART scores and an ART×Sex interaction as predictors in successive blocks. ART scores were mean-centered for the calculation of the interaction term. Multiple regression results are shown in Table 3.

The first block indicated that both education level and personal distress were significant predictors of RMET. Adding ART as predictor in block 2 did not increase the explained variance considerably, but including the ART×Sex interaction in block 3 led to a significantly larger R^2 ($R^2 = 0.113, p = .004$; $\Delta R^2 = .022, p = .030$). In this model, RMET was more strongly associated to both ART ($\beta = 0.329, p = .008$) and ART×Sex ($\beta = -0.256, p = .03$), and was also predicted by education ($\beta = 169, p = 0.032$) and Personal Distress ($\beta = 0.155, p = .029$). Follow up linear regressions showed that the association

Table 2. Spearman Correlations of self-report and ART reading measures, Theory of Mind performance and Trait empathy by sex. Correlation coefficients are shown for the full sample, men and women.

		Educ	SRR	R-a	R-m	R-n	R-e	R-i	R-f	R-nf	ART	Rmet	IRI-f	IRI-pt	IRI-ec	IRI-ed
Age	Full	.579**	-.071	.191**	.084	.422**	.441**	-.011	-.144*	.027	.346**	.099	-.253**	.08	.074	-.253**
	Men	.519**	-.102	.135	.022	.482**	.365**	-.104	-.369**	-.11	.386**	.052	-.146	.103	.238*	-.416**
Educ	Women	.609**	-.057	.224**	.113	.418**	.468**	.031	-.068	.088	.337**	.116	-.308**	.077	-.002	-.163
	Full			.417**	.075	.396**	.502**	.072	-.194**	.052	.187**	.095	-.107	.075	-.078	-.078
SRR	Men			.381**	-.024	.331**	.351**	.023	-.319**	-.003	.450**	.095	-.028	.13	.12	-.194
	Women			.437**	-.131	.423**	.577**	.093	-.131	.076	.320**	.244**	-.138	.059	.118	-.013
R-a	Full			-.116	-.105	.034	-.079	-.126	-.074	-.114	-.192**	-.085	-.171*	-.108	-.061	.054
	Men			.032	-.368**	-.1	-.065	-.039	-.173	-.156	-.249*	-.03	-.175	-.086	-.086	.136
R-m	Women			-.198*	.067	.056	-.095	-.202*	.044	.046	-.221**	-.113	-.136	-.105	.014	.04
	Full				.190**	.264**	.371**	.185**	-.159*	.093	.229**	.12	-.067	-.009	.062	-.083
R-n	Men				.161	.135	.198	.173	-.225	.124	.224	.093	-.075	-.023	-.075	-.215
	Women				.207*	.361**	.472**	.198*	-.138	.082	.244**	.14	-.07	-.006	.119	.007
R-e	Full					.273**	.153*	.042	.013	.421**	.106	.064	-.021	.057	-.001	-.001
	Men					.273*	.163	.097	-.177	.383**	.203	.029	.109	.064	.013	-.077
R-f	Women					.300**	.408**	.156*	-.084	.454**	.066	.073	-.096	.044	-.048	.034
	Full						.408**	.249*	-.148*	.155*	.188**	.029	-.205**	.007	.025	-.267**
R-i	Men						.473**	.099	-.275*	.09	.322**	.108	-.266*	.062	.108	-.359**
	Women						.400**	.099	-.035	.162	.092	.018	-.145	.007	.083	-.174*
R-ec	Full							.275**	-.211**	.049	.190**	.04	-.125	.033	.115	-.185**
	Men							.182	-.304*	.026	.152	-.164	-.127	.094	.081	-.355**
R-ed	Women							.324**	-.176*	.041	.219*	.118	.126	-.002	.117	-.137
	Full								.091	.041	.1	.118	.121	.044	.028	.038
R-nf	Men								.119	.004	.055	.252*	.052	.151	.058	.042
	Women								.081	.059	.126	.044	.200*	-.015	.036	.028
R-pt	Full									.024	-.105	.051	.363**	.051	.133	-.012
	Men									.215	.001	.002	.379**	.062	-.015	.177
R-ec	Women									-.026	-.183*	.013	.302**	.013	.129	-.139
	Full										.033	.025	-.015	.136	.045	-.139*
R-ec	Men										-.1	-.105	.063	.119	.011	-.105
	Women										.104	.113	-.02	.156	.107	-.144
ART	Full										.151*	.151*	-.013	-.015	.106	-.059
	Men										.066	.066	.017	-.069	.201	.018
RMET	Women										.055	.335**	-.005	.044	.127	-.084
	Full											.055	-.046	-.013	.079	.169*
IRI-f	Men												-.007	-.003	.268*	.206
	Women												-.092	-.031	-.047	.138
IRI-pt	Full												.158*	.158*	.234**	.125
	Men												.021	.021	.192	.225
IRI-ec	Women												.207*	.207*	.193*	.023
	Full														.288**	-.164*
IRI-ed	Men														.318**	-.055
	Women														.309**	-.241**
IRI-ec	Full														.063	.063
	Men														.134	.134
IRI-ed	Women															-.038

Notes: ART = Author Recognition Test Score; Educ = Education level; IRI-f = IRI Fantasy Scale; IRI-pt = IRI Perspective Taking Scale; IRI-ec = IRI Empathic Concern Scale; IRI-ed = IRI Emotional Distress Scale; R-a = Academic reading hours per week; R-e = Email reading hours per week; R-i = Internet reading hours per week; R-f = Fiction reading hours per week; R-n = Magazine reading hours per week; R-nf = Reading the Mind in the Eyes Test; R-m = Newspaper reading hours per week; R-n = non-fiction reading hours per week; SRR = Start of Recreational Reading; **p* < .05; ***p* < .01.

between Theory of Mind performance and fiction print-exposure was significant for men ($R^2= 0.134$; $\beta= 0.366$, $p= .002$), but not for women ($R^2= 0.005$; $\beta= 0.069$, $p= .421$).

DISCUSSION

Table 3. Hierarchical linear regression of RMET scores by Fiction print-exposure, controlling for demographic and trait empathy variables.

Step	Variable	β	SE	Std β	T
1	Age	-.001	.147	-.001	-.008
	Sex	1.910	2.252	.061	.848
	Education	3.412	1.221	.211	2.793**
	IRI-F	-.158	.195	-.059	-.812
	IRI-PT	-.006	.229	-.002	-.027
	IRI-EC	.249	.250	.976	.997
	IRI-ED	.473	.222	.153	2.128*
2	Age	-0.04	0.150	-0.024	-0.292
	Sex	2.43	2.271	0.078	1.072
	Education	2.86	1.270	0.177	2.252*
	IRI-F	-0.18	0.195	-0.069	-0.937
	IRI-PT	0.04	0.230	0.012	0.159
	IRI-EC	0.20	0.252	0.060	0.782
	IRI-ED	0.47	0.221	0.153	2.133*
3	ART	0.26	0.172	0.115	1.518
	Age	-0.030	0.148	-0.016	-0.200
	Sex	3.124	2.271	0.100	1.376
	Education	2.719	1.260	0.168	2.158*
	IRI-F	-0.182	0.193	-0.068	-0.941
	IRI-PT	0.078	0.229	0.025	0.340
	IRI-EC	0.129	0.251	0.039	0.511
IRI-ED	0.481	0.219	0.155	2.194*	
ART	0.745	0.279	0.329	2.672**	
ART×Sex	-0.714	0.326	-0.256	-2.192*	

Notes: ART: Author Recognition Test; ART×Sex= Author Recognition Test×Sex interaction; IRI-EC= Empathic Concern; IRI-ED= Emotional Distress; IRI-F= Fantasy; IRI-PT= Perspective Taking; SE= Standard Error; T= T statistic value; β = Beta coefficient; Std β = Standardized beta coefficient; *= $p < .05$; **= $p < .01$.

Exploring the relationship between self-reported reading habits, an objective measure of fiction print-exposure, self-reported trait empathy and performance on a Theory of Mind task, we found that RMET accuracy was associated to ART scores, personal distress (an affective empathy subscale) and education level. Further analysis indicated that Theory of Mind increased significantly with fiction exposure among male participants only, a sex difference that had not been observed in previous research. In addition, subjects with higher fantasy scores reported more frequent fiction reading times. The significance of these findings will be discussed in detail in the following sections.

The fact that fiction print exposure was associated with Theory of Mind accuracy in our sample is congruent with previous research, particularly, with the studies of Mar *et alii* (2006) and Mar, Oatley, and Peterson (2009), which are the most similar to ours methodologically. These works showed that fiction exposure ART scores were weakly, but significantly correlated with RMET performance, while this effect was independent from intelligence (Mar *et alii*, 2006) and personality measures (Mar *et alii*, 2009). It should be noted that Mar *et alii* (2009) reported full sample correlations between RMET and fiction ART ($r= 0.21$ vs $r= 0.151$ in our study) and proportion of explained RMET variance that were similar to our own results ($R^2= 0.13$ and $R^2= 0.113$, respectively). In addition, the aforementioned studies showed that this was not due to a general effect of print-exposure, because non-fiction ART scores were negatively correlated

(Mar *et alii*, 2006) or non-correlated (Mar, 2009) with Theory of Mind measures. The specificity of this effect was further explored in a more recent study (Fong, Mullin, & Mar, 2013), that found significant differences among genre print exposure (measured by ART) associations with RMET scores. After controlling for age, gender, big five personality traits and non-fiction exposure, “Romance” and “Suspense” (in contrast to “Domestic” and “Science Fiction”) genre exposures were associated to Theory of Mind performance (described in this work as “interpersonal sensitivity”). After controlling for exposure to every genre, only Romance remained as a significant predictor. The authors suggested that, in this particular genre, the narrative is primarily driven by interpersonal interactions and relationships; therefore it should be the more suited to evoking and promoting simulation of interpersonal experiences in the reader, a process that is at the core of cognitive empathy.

Fiction exposure effects were also found in preschool children, where exposure to narrative fiction was associated to Theory of Mind abilities (assessed through a battery of tests other than RMET) after controlling for age, gender, vocabulary and parental income (Mar, Tackett, & Moore, 2010). This study found that the effect does not seem to be limited to written fiction, because an objective measure of exposure to children’s movies (but not television) was a significant predictor of Theory of Mind performance too.

Additional evidence suggested that this association was not merely correlational, but a causal one instead. Kid & Castano (2013) proposed that high quality “literary” fiction engages and stimulates Theory of Mind processes because it requires more flexible interpretive resources to infer the characters thoughts and feelings. In contrast, “popular” fiction tends to be more conventional and stereotypical in its depiction of world and characters, failing to promote Theory of Mind because of its predictability and lack of cognitive demands. To test this hypothesis, they compared performance on different Theory of Mind tests after reading non-fiction, literary and popular fiction excerpts (or nothing at all), in a series of experiments. In this work, RMET was considered a measure of “affective” Theory of Mind (although it is typically regarded as an index of cognitive empathy, as was noted in Olderbak *et alii*, 2015), “cognitive” Theory of Mind was assessed through false belief tasks and the Yoni task was administered as a measure of both. The authors found that short-term exposure to literary fiction significantly improved RMET performance over reading non-fiction and popular fiction, while long-term fiction exposure assessed by ART was also a significant predictor of it. Reading literary excerpts also increased performance in the more complex Yoni task, but ART scores were not correlated with it. The authors concluded that, while cognitive and affective processes might be affected by reading in general, Theory of Mind is selectively stimulated by literary fiction, due to its higher demand on the reader’s empathic inferential processes. They also pointed out that, given that their version of the ART included both popular and literary fiction authors, additional research was needed to study the effects of long-term exposure to high quality fiction specifically. The present study applied a version of the ART that consisted mostly of Nobel Prize (or some other prestigious regional or local award) winners and classic authors, therefore, the effects we found are more likely to be due to contact with “literary” rather than “popular” fiction. Convergent evidence to Kid & Castano (2013) was reported by Black & Barnes (2015), who replicated the literary fiction effect on RMET performance, but not on a non-social cognition task (*intuitive physics test*), and by Pino & Mazza (2016), who found similar effects on a variety of cognitive empathy tasks (referred as *mentalizing*) but not on self-reported affective empathy (referred as *emotional sharing*). On the other hand, Djikic, Oatley,

& Modoveanu (2013) and Panero, Weisberg, Black Goldstein, Barnes, Brownell, & Winner (2016) failed to observe significant differences in RMET performance between groups who read short fiction vs non-fiction texts, but they did replicate the association between ART and RMET scores.

In summary, evidence from correlational studies (such as ours) using indirect objective estimates of lifelong exposure to print fiction (ART) and experimental studies that manipulated short-term exposure to excerpts (Kid & Castano, 2013), short stories (Black & Barnes, 2015) or entire novels (Pino & Maza, 2016) suggest that reading fiction engages and promotes Theory of Mind processing, leading to better performance in cognitive empathy tasks. This finding is congruent with different lines of research showing that interpersonal experience and socioemotional stimulation may have a positive impact on cognitive aspects of empathy. For instance, clinical experience has been associated to better Theory of Mind task performance in both physicians (Handford, Lemon, Grimm, & Vollmer-Conna, 2013) and psychotherapists (Georgi, Petermann, & Schipper, 2014). In addition, neuroscience studies indicate that fiction reading and social cognition both recruit the default brain network, a subset of brain circuits that support our capacity to simulate hypothetical scenes, spaces and mental states (Tamir, Bricker, Dodell-Feder, & Mitchell, 2015). Functional overlaps have been reported between reading and mentalizing tasks in fMRI studies (for a review, see Mar, 2011). Crucially, a recent study found that dorsomedial prefrontal cortex (a subcomponent of the default network) activation in response to written social content mediated the relation between fiction reading and social cognition performance (Tamir *et alii*, 2015). This suggests that simulation of social context in fiction might be the causal link between fiction exposure and enhancement of cognitive empathy.

Both correlation and linear regression analysis suggested that the association between ART and RMET scores was significant for males, but not for females. This result is in contrast with Mar *et alii* (2009), who found the inverse pattern (the association was significant for females only). While this might be reflecting a ceiling effect for women in Theory of Mind performance, their RMET scores did not differ significantly from those of men in our study. Another puzzling finding was the inverse correlation between self-reported fiction reading times and RMET scores observed in females only. This negative or lack of effects of fiction exposure in the women group may be a result of differences in the type of fiction they are exposed to (for instance, exposure to popular rather than literary fiction, as Kidd & Castano (2013) suggested). However, ART scores did not differ significantly between men and women, which indicates that exposure to high-quality fiction is not likely to be the cause of the sex differences we found in our study. Regarding trait empathy, women obtained significantly higher scores on Empathic Concern and Fantasy. Empathic concern was associated with RMET scores for men (but not for women), in our study, and Fantasy has been previously reported to correlate with RMET (*et alii*, 2009), but we failed to observe that association in our own data.

While this sex difference in fiction exposure and Theory of Mind association cannot seem to be easily attributed to any of the variables we considered in the present study, there are other factors that might account for it. For instance, Openness to experience is a personality trait from the big five model that has been previously identified as an independent predictor of RMET score (Mar *et alii*, 2009). It has also been shown to mediate IRI Perspective Taking increases after reading a short story (the effect was significant only for those subjects with low Openness to experience scores) (Djikic *et alii*, 2013). In addition, men tend to score lower on emotional and aesthetic aspects of

Openness than women (Costa, 2001; Weisberg, 2011). If the men in our study were indeed lower in Openness, this might have rendered them more susceptible to lifelong fiction exposure effects on their cognitive empathy. It should be noted, however that this mediating effect was observed on a self-report cognitive empathy measure, and has not been reported for RMET performance. In addition, verbal intelligence and vocabulary are also strong predictors of RMET scores (Olderbak *et alii*, 2015; Peterson & Miller, 2012), and might be potential mediators of fiction exposure effects. On this regard, while we did not control for verbal IQ individual differences, we did repeat the correlation analysis excluding 14 women who had not received university education (none of the men fell into this category, which might have created an education bias), and found a similar pattern of results (RMET and ART correlation: $Rho = 0.027$, $p = 0.771$). Therefore, we cannot provide direct or indirect evidence that our findings might be related to differences in verbal ability or education.

In synthesis, the lack of association between ART and RMET scores in women cannot be easily explained by the variables considered in our study, and requires replication and further clarification. Future studies should consider including personality traits other than empathy measures (like Openness) and verbal IQ measures to account for potential sex differences in fiction exposure effects.

Interestingly, significant correlations were found between self-reported measures of reading habits and empathy, and between the objective measures of fiction exposure and Theory of Mind, but self-report and objective variables were mostly (although not entirely) independent from each other. Specifically, higher fiction reading times and earlier start in recreational reading correlated with IRI Fantasy scores, indicating a logical relation between exposure to fiction and the tendency to empathize with fictional characters. On the other hand, average reading times were not predictors of ART scores and cognitive empathy subscales were not associated with RMET scores (although significant correlations with affective empathy subscales were observed: Personal Distress -full sample level- and Empathic Concern -men group only-). A previous study also failed to find significant correlations between IRI subscale and RMET scores (Melchers *et alii*, 2015), and the authors indicated that this lack of compatibility between self-report and performance measures could be at least partially explained by the distinction between questionnaires, that measure self-perception, and behavioral tasks, which measure abilities. The same logic can be applied to explain the independence between reported reading habits (which are subjective estimates of the time the subjects are exposed to different kinds of texts) and ART scores (which provide an indirect, but objective measure of exposure to written fiction and, particularly, to laudated or classic authors, in this version).

Regarding the limitations of our study, we should begin by stressing that the relationship we found between fiction reading and Theory of Mind is correlational and we cannot directly infer a causality effect from it. However, this interpretation is in line with experimental research on the effects of reading over several measures of Theory of Mind and empathy. In addition, the study was conducted as an online survey promoted through social networks, and our sample consisted mostly of university students and graduates (91.4%). As a result, sampling method was not probabilistic and the results may not be easily generalized to populations with lower education levels. On the other hand, our regression model showed that fiction reading effects were significant after controlling for education, and a previous study (Mar, Tackett, & Moore, 2010) found the same effect in children. Therefore, it is unlikely that the effect is limited to the highest education levels. Regarding the potential limitations of online surveys for data

collection, it should be noted that a similar procedure has been used in a large-scale study of RMET task (Olderbak *et alii*, 2015) and in a previous studies of fiction genre exposure effects on Theory of Mind (Fong *et alii*, 2013). Furthermore, the results from our online survey are in line with previous research using traditional data collection methods (Mar *et alii*, 2006, 2009).

The fact that we used a brief form of the RMET task (Olderbak *et alii*, 2015) instead of the original version could be considered a limitation, but we should point out that: 1) the brief form has shown higher correlations than the original with cognitive empathy scales, 2) the correlation we found in the full sample using the brief RMET form was similar in magnitude to those reported in previous studies with the original form (Mar *et alii*, 2006, 2009). On the other hand, Olderbak *et alii* (2015) noted that RMET scores were highly correlated with vocabulary (both in the traditional and brief forms), therefore, we cannot rule out the possibility that the increase in Theory of Mind ability has been mediated by language stimulation and not mentalizing processes engaged by reading. Future studies should attempt to replicate these findings using non-verbal or less language-biased Theory of Mind tasks. Finally, the absence of fiction reading effects in women should be replicated in a sample with more similar number of males and female participants.

Our study constitutes a cross-cultural replication of the association between lifelong written fiction exposure and Theory of Mind ability, observed for the first time in a Latin American sample with a brief form of the RMET task. The most likely interpretation of this association is that reading fiction engages mentalizing processes in order to simulate the characters intentions and feelings, which leads to an increase of Theory of Mind ability in the reader. This effect, however, was only significant in men, and its absence in women could not be accounted for by the variables considered in the study. Therefore, future studies should further investigate this potential sex difference considering additional variables, like personality traits, verbal IQ and fiction genre preferences. In addition, non-verbal or less linguistically-biased Theory of Mind tasks should be administered to control for RMET's high reliance on vocabulary.

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APPENDIX

Author Recognition Test

<i>Real Authors List</i>	<i>Foil Authors List</i>
Mario Benedetti	Thomas J. Carev
Ricardo Piglia	Nélida Cornejo
George Orwell	Michael Dougher
Alejandra Pizarnik	Perry Fuchs
José Saramago	Milagros Gallo
Paul Auster	Ana Delgado
Arturo Pérez Reverte	Phillip Himeline
Miguel Hernández	William Baum
Herman Hesse	Steve Graham
Milan Kundera	Guillermo Vallejo Seco
Haruki Murakami	Fernando Cuetos
Ray Bradbury	Eduardo Fonseca
Albert Camus	Leandro Almeida
Samuel Beckett	Robert Flynn
Umberto Eco	Amaia Bravo
Mario Vargas Llosa	Stephen Higgins
Manuel Puig	Joaquín Fuster
Victoria Ocampo	Ronald K. Hambleton