

**Testing correlates of lifetime exposure to print fiction following a multi-method
approach: Evidence from young and older readers**

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Abstract

Two pre-registered studies investigated associations of lifetime exposure to fiction, applying a battery of self-report, explicit and implicit indicators. Study 1 ($N=150$ university students) tested the relationships between exposure to fiction and social and moral cognitive abilities in a lab setting, using a correlational design. Results failed to reveal evidence for enhanced social or moral cognition with increasing lifetime exposure to narrative fiction. Study 2 followed a cross-sectional design and compared 50-80 year-old fiction experts ($N=66$), non-fiction experts ($N=53$), and infrequent readers ($N=77$) regarding social cognition, general knowledge, imaginability, and creativity in an online setting. Fiction experts outperformed the remaining groups regarding creativity, but not regarding social cognition or imaginability. In addition, both fiction and non-fiction experts demonstrated higher general knowledge than infrequent readers. Taken together, the present results do not support theories postulating benefits of narrative fiction for social cognition, but suggest that reading fiction may be associated with a specific gain in creativity, and that print (fiction or non-fiction) exposure has a general enhancement effect on world knowledge.

Keywords: fiction, empathy, theory of mind, knowledge, imagination, creativity

Introduction

Fiction, typically defined as an artifact that is intended and understood to deal primarily with non-real events, objects, and persons (e.g., Gertken & Köppe, 2009), is part of our everyday lives. Public discourse frequently airs the claim that fiction can be a valuable source of truth or insight, as well as adding to our creative and imaginative capacities. This claim is often echoed within the humanities (Boyd, 2009, Chapter 24; Nussbaum, 1997). Fiction's effects on imagination are said, in turn, to explain some of the moral power of fiction—strengthening empathy and sensitizing us to the needs of others (Nussbaum, 1996), an idea commensurate with Haidt's (2003) emphasis on the emotional basis of morality. It is also said to promote ethical thinking (Diamond, 1991) and even to help us detect moral character (Kieran, 2013). Recently, psychologists have begun to test some of these claims, focusing largely on social cognition.

Social cognition is a multi-faceted construct referring to the perception, interpretation and response to social information that helps us navigate interpersonal relationships in a variety of contexts (Fiske & Taylor, 2013). Empathy, the ability to share the feelings of others while being aware of the self-other distinction (Singer & Klimecki, 2014), and Theory of Mind (ToM), the capacity to comprehend others' inner life (Wellman, Cross, & Watson, 2001), are considered two key components of social cognition. Since deficits in both empathy and ToM have been linked with clinical disorders (Baron-Cohen, 2000; Bora & Berk, 2016; Bora, Yucel, & Pantelis, 2009; Derntl, Seidel, Schneider, & Habel, 2012; Hobson, 2007; Lee, 2007), the promotion of social cognitive abilities appears to be important across various social levels, ranging from individuals to entire societies. It is worth noting, however, that increasing social cognitive abilities does not inevitably lead to morally good outcomes. Although empathy is often associated with prosocial virtues, it can be used for manipulation

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and deception (e.g. Bloom, 2016; Breithaupt, 2018; Bubandt & Willerslev, 2015; Vermeule, 2010).

It has been suggested that reading (fictional) stories improves social cognition because stories typically deal with characters and their social relationships, and so readers must deploy their social cognitive abilities in order to comprehend narratives (e.g., Calarco, Fong, Rain, & Mar, 2017; Deane, Somasundaran, Lawless, Persky, & Appel, 2019; Mar, 2018a, 2018b; Salem, Weskott, & Holler, 2017). Furthermore, the social content of (fictional) narratives often widens the range of social information individuals are exposed to by describing experiences they have never had, or by presenting events from novel viewpoints (Calarco et al., 2017). Mar (2018b) assumes that narratives (including fictional ones) influence social cognitive processes as a result of frequent engagement over prolonged periods of time; such an influence should therefore manifest itself best through positive correlations of social cognition with lifetime exposure to such texts. Indeed, there is some evidence to support a positive relationship between reading narrative fiction and social cognitive abilities: According to a meta-analysis (Mumper & Gerrig, 2017) summarizing 30 correlational studies, both lifetime narrative fiction and expository non-fiction reading have shown significant, though weak, positive associations with empathy and ToM, with consistently stronger associations for narrative fiction than for expository non-fiction reading.

However, the extant evidence base is limited by a narrow focus on social cognition that mainly excludes morality (for an exception see Black & Barnes, 2020). This focus on *social cognition* does not enable assertions about fiction-based improvements of *morality*, as claimed in the literary and philosophical literature sampled above. In addition, the indicators of social cognition applied in previous research, though easily administered in experimental settings, have limited validity due to a reliance on either self-report measures (c.f. Mumper & Gerrig, 2017; see also Ilgunaitė, Giromini, & Di Girolamo, 2017) or the Reading the Mind in

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the Eyes Test (RMET; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). Despite its widespread application, this measure has been criticized for its association with verbal intelligence (Baker, Peterson, Pulos, & Kirkland, 2014); there are also concerns that it reflects emotion recognition rather than ToM (Oakley, Brewer, Bird, & Catmur, 2016; see also Mar, 2018b). In Study 1 we therefore employed a greater variety of tasks to measure social and moral cognition, including implicit tasks that are less susceptible to demand characteristics.

Although recent empirical investigations of fiction-based effects have focused on social cognition, scholars have long discussed further areas of potential benefits (see above), in particular knowledge and imaginative capacities. Some empirical studies suggest that fictions in various media can be successful in conveying factual knowledge, though retention is fragile (Brodie et al., 2001). Other studies indicate that reading fiction might impair the acquisition of factual knowledge insofar as readers fail to scrutinize information contained in fictional narratives, something reflected in subsequent false answers on general knowledge tests (Gerrig & Prentice, 1991; Marsh & Fazio, 2006; Marsh, Meade, & Roediger, 2003; Prentice, Gerrig, & Bailis, 1997; Wheeler, Green, & Brock, 1999). However, some of these studies lacked non-fiction control conditions that would have enabled claims about effects specific to fiction, and all used artificially created texts designed to make it harder to discriminate between true and false information. Competent readers of naturalistic fiction are unlikely to be misled in these ways (Friend, 2014). Thus, frequent reading of fiction should be just as suitable for knowledge acquisition as is frequent reading of non-fiction.

Another potential area where fiction-based benefits may be found is imaginative capacities. Some scholars argue for a very close, even definitional relation between fiction and imagination (Currie, 1990; Stock, 2017); others who dispute this typically still agree that activation of the imagination is an important role that fiction plays in our lives (Abell, 2020;

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Friend, 2011, 2012), and where fictions trade in non-existent entities imagination seems important for grasping the content of the story. While non-fictions may exercise some imaginative capacities (e.g., imagery, counterfactual thinking and the construction of ‘situation models’ (van Dijk & Kintsch, 1983) or ‘mental models’ (Johnson-Laird, 1983)), it is widely agreed that imaginative capacities are more strongly exercised by reading fiction than non-fiction. First, fictions require us to imagine individuals and events that do not exist and have not occurred. Second, fictions often present inside views of the mental states of characters, which readers would never encounter in real life or in typical non-fiction works (Mar & Oatley, 2008). Creativity, which is often described as involving the production of novel, surprising, and useful or valuable products (e.g., Boden, 2003; Mumford, 2003), is a capacity that at least partly depends on the ability to imagine, i.e. imaginability (e.g., Pelaprat & Cole, 2011). Hence, creativity should benefit from (fiction-based) enhancement of imaginability. Taken together, reading fiction can be assumed to be associated with specific advantages for imaginative capacities including imaginability and creativity.

In this paper we present two pre-registered studies that test the degree to which social cognitive abilities are associated with reading narrative fiction. Study 1 additionally addresses relationships with morality, while Study 2 goes beyond social cognition by examining links with general knowledge, imaginability, and creativity.

Study 1

Study 1 investigated the relationship between lifetime fiction reading and social cognitive abilities and morality in a correlational design. Our broad battery of social and moral cognition tests included seven tasks. Empathy was measured using self-report questionnaires, the Interpersonal Reactivity Index (IRI; Davis, 1980, 1983) and the Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004), that have been widely used in previous

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studies on fiction reading (e.g. Bal & Veltkamp, 2013; Johnson, Jasper, Griffin, & Huffman, 2013; Liu & Want, 2015; Pino & Mazza, 2016). In addition, affective empathy was assessed using an eye-tracking paradigm, based on evidence that individuals with high trait empathy focus their gaze more frequently on the eye-region of their conversation partner (Cowan, Vanman, & Nielsen, 2014), and that adapting oneself to the emotional state of others is expressed via changes of pupil dilation (Michalska, Kinzler, & Decety, 2013; Sirois & Brisson, 2014). Empathy for other's pain was indexed by a computerized pain rating task (cf. Singer & Frith, 2005). We also implemented the RMET as a measure of emotion recognition, since sensitivity to emotion and understanding of mental states feature strongly in the humanistic and psychological literatures on the value of fiction (Mar, 2018a; Nussbaum, 2001).

Morality was assessed, firstly, in terms of the Immediate Affect towards Moral Stimuli (IAMS) task. This reflects participants' affective reactions towards morally positive/negative stimuli, which have been associated with guilt feelings in a moral dilemma, and with emotional reactions to/rejection of an unfair offer (Hofmann & Baumert, 2010). Secondly, an Implicit Association Test (IAT) measured participants' moral vs. immoral self-concept, which predicts moral actions such as honest behaviour despite negative consequences (Perugini & Leone, 2009).

In sum, in Study 1 social cognition was assessed using a battery of indicators including self-report, but also behavioural and implicit measures, thereby increasing methodological rigor and explanatory power compared to all previous studies that have tested associations of fiction reading with social cognition. Outcomes under investigation also go beyond empathy and ToM to include implicit morality. This allowed us to consider the extent to which fiction-based improvements in social cognition have implications for moral

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advancement. We tested the hypothesis that lifetime narrative fiction reading is positively related to these outcomes.

Methods

The Research Ethics Committee of the XXXXXXXXX at the XXXXXXX, approved this correlational study before participant recruitment. The methods used in this study were pre-registered as part of a longitudinal trial on the Open Science Framework, https://osf.io/kde6y/?view_only=fa9cc24b6d3b47eea7612115fd0eefdf, though only the data from time 1 is analyzed here.

Participants

A total of 154 young adult participants were recruited from the XXXXXXX student participant pool, 150 of whom were included in the final analyses. Individuals were eligible if English was their first language. Two participants were excluded for being non-native English speakers, and two participants were excluded because they selected more than two mock authors from the Author Recognition Test-Genres (ART-G), which can suggest dishonest responding. The sample size reflects practicality in terms of time, money, personnel, and lab space. The total sample size of $N=150$ had a power of $1-\beta = .96$ for detecting a medium size correlation of $r=.30$, and a power of $.23$ for detecting a small size correlation of $r=.10$, adopting a two-tailed significance level of $\alpha<.05$. All participants provided written informed consent before data collection and were reimbursed with course credits or payment of £12.00. The mean age of the final sample was 20.09 years ($SD=2.97$), and 82.7% were female.

Assessment measures

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Lifetime exposure to print. ART-G (Mar & Rain, 2015) provided an indicator of reading habits. Participants were asked to accurately recognize the names of 110 authors of narrative fiction and 50 authors of expository non-fiction (targets) among names of 40 non-authors (foils). Fiction and non-fiction sub scores were calculated from the number of selected authors for each genre, i.e. the fiction sub score is the sum of correctly identified fiction authors, the non-fiction sub score is the sum of correctly identified non-fiction authors¹.

Trait empathy. Two self-report questionnaires were used to assess participants' trait empathy. In the Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004), 40-item version, respondents are asked to indicate the degree to which they agree with statements, such as 'I can easily tell if someone else wants to enter a conversation', using a 4-point rating scale that ranges from *strongly disagree* to *strongly agree*. Negatively worded items were reverse-coded, and a sum score with a possible range of 0 to 80 was calculated for each respondent, with higher scores indicating greater levels of empathy. In the current sample Cronbach's α was .87.

The Interpersonal Reactivity Index (IRI; Davis, 1980, 1983) assesses four components of trait empathy: fantasy, perspective-taking, empathic concern, and personal distress. Participants responded to 28 items, seven items for each subscale, on a 5-point Likert scale ranging from *Does not describe me well* to *Describes me very well*. IRI scores for each

¹ Unlike the scoring procedures of the ART version by Stanovich and West (1989), foils were not subtracted from hits because the authors of ART-G do not provide instructions of this type; this may be related to the fact that the ART-G has subscales whereas the ART by Stanovich & West (1989) is unidimensional. It is therefore not clear how the number of foils is to be subtracted from multiple subscales. Since we excluded participants selecting more than two foils, the penalty for foil checking was very strict (see above). Hence, the final sample for analyses had limited variance of ART-G foils so that further control measures did not seem required.

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subscale range from 0 to 28, with a higher score indicating greater tendencies to that trait. In the present sample Cronbach's α for subscales ranged between .71 and .78.

Empathy for others' pain. To examine empathy for others' physical and social pain we adapted the paradigm used in Perry, Bentin, Bartal, Lamm, and Decety (2010).

Participants were presented with images of hands and feet in painful or non-painful situations (e.g. involving pressure, heat, lacerations, embarrassment, grief, misery, etc.). Forty images (10 physical pain, 10 physical no-pain, 10 social pain, and 10 social no-pain) were presented for 3sec each in a random order, and participants were asked to judge each photo on the intensity of pain that they thought the person would feel in each situation on a visual analog scale from 0 (no pain) to 100 (worst possible pain). An average pain rating was recorded for each participant and condition, and difference scores were calculated by subtracting the mean rating for non-painful stimuli from painful stimuli, with more positive difference scores indicating greater empathy for others' pain. We note that EEG data was also collected during this task. However an intermediate analysis of the data revealed excessive background noise in the EEG signal which masked any effects in the frequency ranges of interest (i.e. alpha and low beta). Therefore, we stopped data collection on this task at $N=69$, and report only the behavioural data here².

Affective empathy. Participants' level of affective empathy was assessed using an eye-tracking paradigm based on Cowan, Vanman, and Nielsen (2014). Participants watched two 3-min videos in which a female actor describes either a sad or a neutral story in a monologue. An SR Research Eyelink 1000 eye-tracker monitored their eye movements and pupil dilation throughout each video. Between the two videos, participants performed a simple distractor task, requiring them to listen to and repeat back three numbers. After each video, participants rated on a 5-point scale how sad they found the video (for the sad film), or

² This sample size yielded a power of $1-\beta = .66$ to detect a medium size correlation of $r=.30$.

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how emotionally arousing they found the video (for the neutral video; as in Cowan et al., 2014). Order of videos was randomized. The difference in pupil size (average pupil size during sad video – average pupil size during neutral video), and percentage dwell-time to the eye-region (calculated by summing the duration of fixations to the eyes across both videos and dividing it by the sum of fixation durations for the entire videos) were calculated and served as empathy indices. In addition, higher affective empathy was indicated by higher sadness ratings of the sad video.

Emotion recognition. We measured emotion recognition using the Reading the Mind in the Eyes Test-Revised (RMET; Baron-Cohen et al., 2001). Better emotion recognition skills were indexed by a high relative frequency of correct responses. To reduce time burden on participants, the original set of 36 items was split into two equally difficult halves, as in Samur, Tops, and Koole (2018, Experiment 3), based on the item accuracy reported for university students (Baron-Cohen et al., 2001). Each participant received one test-half only; allocation was counterbalanced across participants.

Implicit morality. First, the implicit affect towards moral stimuli (IAMS) task followed the experimental procedure and stimuli applied by Hofmann and Baumert (2010). In each trial, participants were asked to categorize a Chinese pictograph as ‘pleasant’ or ‘unpleasant’ using two response keys on the keyboard. Shortly before the Chinese pictograph was presented, a moral prime (e.g. an elderly couple walking arm-in-arm, or a man directing a gun into the camera), or control picture (e.g. a lightning striking a mountainside) appeared for 100ms. It is assumed that the affective reaction to the moral primes presented is misattributed to the Chinese pictograph, thus influencing the response. We used 10 pictures of morally positive behaviours and 10 pictures of morally negative behaviours as moral primes. As comparison pictures, we included 10 non-moral pictures of positive valence, as well as 10 non-moral pictures of negative valence. Responses exceeding a threshold of

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2000ms (2.80% of all responses) or falling below 350ms (14.34% of all responses) were considered outliers and excluded from analyses. To achieve an indicator of immediate affect towards moral stimuli, the individual difference index of the IAMS was calculated for each participant (cf. Hofmann & Baumert, 2010; proportion of ‘positive’ judgements on trials in which a Chinese pictograph was preceded by a positive moral prime *minus* percentage of ‘positive’ judgements on trials in which a Chinese character was preceded by a negative moral prime). To control for general, morally unrelated affect, the individual differences index of the IACS (immediate affect towards control stimuli) was computed (i.e. proportion of ‘positive’ judgements on trials with positive morality-irrelevant primes *minus* the proportion of ‘positive’ judgments on trials with negative morality-irrelevant primes). Data of participants ($N=4$) who were familiar with Chinese characters was excluded from analysis of the IAMS task.

Second, we applied an Implicit Association Test (IAT) of implicit moral identity (implicit moral identity IAT), with the experimental procedure and stimuli replicating Perugini and Leone (2009), and following the standard IAT sequence (Greenwald, McGhee, & Schwartz, 1998). The target categories were ‘Moral’ (represented by the stimulus words: honest, sincere, faithful, modest, altruist) *vs* ‘Immoral’ (represented by the stimulus words: deceptive, arrogant, dishonest, cheater, pretentious), and the paired categories were ‘Me’ (represented by the stimulus words: I, me, myself, self, my) *vs* ‘Others’ (represented by the stimulus words: them, they, others, your, you). Implicit moral identity was indexed by the D6 measure (Greenwald, Nosek, & Banaji, 2003), because we wanted to replicate procedures by Perugini and Leone (2009), and this indicator has proven to outperform other error-penalty formulas (Greenwald et al., 2003). D6 is calculated as the mean latency in the ‘immoral-me’ block *minus* the mean latency in the ‘moral-me’ block, divided by the individual standard deviation of latencies across ‘immoral-me’ and ‘moral-me’ blocks. In line with the D6

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scoring algorithm, responses with latencies below 400ms or above 10,000ms were excluded from analysis, and latencies of errors were replaced by the block mean of correct-response latencies plus 600ms. Higher scores express a stronger implicit moral self-concept.

Procedure

All assessments took place as individual testing sessions in a laboratory at XXXXXXXXXX. Participants first completed the questionnaires in the following order: Demographics questionnaire, EQ, ART-G, IRI. Subsequently, participants performed the eye-tracking paradigm, followed by the IAMS task, the implicit moral identity IAT, the RMET, and the empathy for others' pain task (where applicable). Completion took approximately 1 hour 20 min, or ~40 min without the pain task.

Data analysis

The association of lifetime fiction reading with social cognition was investigated through bivariate correlations of the ART-G fiction sub score with all indicators of social and moral cognition, and partial correlations controlling for non-specific contribution of non-fiction reading via the ART-G non-fiction sub score. The significance level for each test was corrected for the 13 correlations using Bonferroni correction ($p_{crit} = .0038$).

Results

Due to calibration problems, data of 11 participants could not be used for the eye-tracking paradigm. Data of four participants in the IAMS task could not be analyzed because they were fluent Chinese speakers. Data of 7 participants could not be used for the pain task due to technical or comprehension problems. There were no further missing data.

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Descriptive statistics for the dependent measure in each assessment task are summarized in Table 1, and plotted in Figure 1. Preliminary analyses confirmed that participants clearly distinguished painful from non-painful images in the pain task ($M_{\text{diff}} = 23.31$). Overall patterns in the eye-tracking paradigm replicated the basic effects seen in Cowan et al. (2014). As expected, the sad video was rated as moderately sad ($M = 3.63$), and pupil diameter was greater during the sad than neutral video ($M = 1004.10$ vs 991.93). These affective ratings are comparable to those reported in Cowan et al. (2014). However, in contrast to Cowan et al. (2014), percentage dwell-time on the actor's eye region (averaged over both sad and neutral videos) did not significantly correlate with the IRI Perspective Taking scale, $r = -.119$, $p = .168$, nor with any other empathy scale under investigation, IRI Fantasy: $r = -.028$, $p = .749$, IRI Personal Distress: $r = .061$, $p = .484$, IRI Empathic Concern: $r = -.022$, $p = .798$, EQ: $r = .039$, $p = .653$. This suggests that this task may not have accurately assessed empathy in the present sample. Overall accuracy on the RMET was good ($M = .74$). Preliminary analysis of the IAMS task confirmed that participants were significantly more likely to judge a pictograph as pleasant after a positive moral prime than after a negative moral prime ($M = .61$ vs $.40$; $t(145)=8.58$, $p<.0001$, $d=0.72$), and more likely to judge a pictograph as pleasant after a morality-irrelevant positive control stimulus than after a negative morality-irrelevant control stimulus ($M = .65$ vs $.42$; $t(144)=8.21$, $p<.0001$, $d=0.67$). Finally, the positive mean D6 value ($M = .60$) in the implicit moral identity IAT confirmed previously observed preference for implicit moral self-concept (Perugini & Leone, 2009).

Correlations are summarized in Table 1. Bivariate correlations showed that the ART-G fiction sub score was not significantly correlated with any of the measures of social cognition (all $ps \geq .007$, $p_{\text{crit}} = .0038$). Replicating previous findings (e.g. Mar, Oatley, Hirsh, Dela Paz, & Peterson, 2006) and warranting partial correlations, the ART-G fiction and non-

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fiction sub scores were strongly interrelated, $r=.728$, $p<.001$. After controlling for exposure to non-fiction reading via the ART-G non-fiction sub score, correlations between the ART-G fiction sub score and measures of social cognition were all non-significant ($ps \geq .128$).

—Insert Table 1 here—

—Insert Figure 1 here—

Discussion

Although Study 1 relied on a broad range of social cognitive indicators, which aimed at maximizing explanatory power, results did not support the notion that lifetime exposure to narrative fiction is positively related to social cognition. After correlations were controlled for the non-specific contribution of non-fiction exposure and adjusted for multiple comparisons, no significant associations between exposure to narrative fiction and social cognition/implicit morality emerged. This pattern of results seems to conflict with a recent meta-analysis by Mumper and Gerrig (2017) that detected significant positive correlations between lifetime reading of narrative fiction and social cognition, even after controlling for expository non-fiction reading. However, the original studies involved in this meta-analysis are not directly comparable with the present investigation due the novel indicators of social cognition and morality used here.

It is possible that the lack of significant relationships is due to characteristics of the current sample, in particular its homogeneity. Given that the maximum score of the ART-G fiction sub score was 110, the present sample achieved low values not only regarding variability of exposure to written fiction ($SD = 8.24$), but also with regards to overall performance ($M = 6.31$). In other words, the participants of the present sample had gathered very little experience with written fiction over their lifetime so far, and the differences

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between participants in this respect were small. This could be a result of the young – and again relatively invariable – sample age ($M = 20.09$, $SD = 2.97$), in the sense that respondents were simply too young to have been exposed to a large amount of print fiction. Yet, existing relationships between variables can only be revealed if these variables vary to a sufficient degree, that is, if their so-called primary variance (e.g. Reiß & Sarris, 2012) exceeds a certain level. Hence, the lack of variation could account for the absence of significant correlations.

Study 2

In Study 2 we improved the study design by following the classic max-min-con principle of experimental psychology (Kerlinger, 1973, 1979), i.e., maximizing the ‘signal’/primary variance while minimizing ‘noise’/error variance and controlling systematic bias/secondary variance. The signal was maximized through between-group comparisons (e.g. Reiß & Sarris, 2012) of three types of target audience, namely fiction experts, non-fiction experts, and infrequent readers. Fiction experts were the actual target group, whereas non-fiction experts controlled for fiction-unspecific effects of reading in general, and infrequent readers controlled for potential reading-unspecific influences such as age cohort. As in Study 1, application of measurement instruments with established reliability and validity helped minimize noise (e.g. Reiß & Sarris, 2012). Systematic bias was controlled for by recruiting participants comparable in age. Thus, all participants should have had similar opportunities, at least per amount of lifetime, to engage with written (non-)fiction, so that group differences regarding lifetime print exposure could to a large degree reflect purposeful decisions of the individual.

Another way to maximize the signal is to include further outcome variables so as to provide the independent variable with a range of suitable instances for exhibiting effects. According to the results of Study 1, social cognition – and possible downstream effects like

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morality – might in fact not be outcomes affected by reading fiction. Indeed, as outlined above, scholars have suggested further areas in addition to social cognition that might be affected by reading fiction, in particular general knowledge and imaginative capacities in terms of imaginability and creativity. Therefore, Study 2 examined the relationship of lifetime fiction reading with social cognition, general knowledge, imaginability, and creativity in a cross-sectional design contrasting fiction experts with non-fiction experts and infrequent readers.

Compared with Study 1, empathy was assessed using only the EQ (due to time restrictions), thus enabling comparisons with previous works that have used this measure, including Study 1. The RMET was replaced by the Strange Stories task, a well-established indicator of ToM, so as to facilitate examination of ToM rather than simply emotion recognition. In addition, we included a vocabulary test reflecting general knowledge, an imaginability task mirroring imaginative capacities, and a Remote Associates Test indicating creativity. The tasks used in Study 1 for assessing morality were dropped, firstly to reduce the time burden for participants, and secondly because we considered morality as a rather secondary outcome of social cognitive abilities. As distinct from Study 1, Study 2 was implemented online, since laboratory-based research was not possible due to the Coronavirus pandemic, and online studies provide easier access to the more heterogeneous target group of this investigation (Gosling & Mason, 2015).

We tested the hypothesis that fiction experts would outperform non-fiction experts and infrequent readers regarding empathy, ToM, imaginability, and creativity. It was also predicted that fiction and non-fiction experts would score higher regarding general knowledge than infrequent readers.

Methods

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This non-randomized controlled trial followed a cross-sectional design involving one between-subjects factor, group, with three levels (fiction experts *vs* non-fiction experts *vs* infrequent readers), and was approved by the Research Ethics Committee of the XXXXXX at the XXXXX before study commencement. The methods and analysis protocols were pre-registered on the Open Science Framework, https://osf.io/bpv4s/?view_only=6ec4a4df52084e98840d1f0749eabe6e; an amendment to the pre-registration can be found at https://osf.io/9qwmv/?view_only=017e5b798c1c403991f0077630303eca.

Participants

An A priori power analysis using G*Power revealed that a total sample size of $N=158$ ($N=53$ per group) would be necessary to detect a medium effect size of $f=.25$ at the standard $\alpha<.05$ significance level with a power of $1-\beta=.80$. Thus, we targeted a minimum sample size of $N=53$ per group. To meet eligibility criteria, participants had to be native English speakers and their age had to be between 50 and 80 years. Participants were excluded from analyses if they selected more than two mock authors in the ART-G or if they did not pass an attention check item hidden within the EQ. Participants were recruited via Prolific Academic ($N=178$ in the final sample were recruited via Prolific Academic) and the University of the Third Age (<https://www.u3a.org.uk/>) as well as via local social media and web pages ($N=18$ in the final sample were recruited via these means other than Prolific Academic). All participants provided written informed consent before data collection and were reimbursed with payment of £10.00, either via bank transfer or an electronic shopping voucher of this value.

The target sample was achieved after $N=337$ participants. See Figure 2 for a schematic of the flow of participants through the study. The final sample consisted of $n=66$ fiction experts (74.24% female, $M_{age} = 59.07$, $SD_{age} = 7.44$), $n=53$ non-fiction experts

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(58.49% female, $M_{age} = 61.85$, $SD_{age} = 6.86$), and $n=77$ infrequent readers (59.74% female, $M_{age} = 58.81$, $SD_{age} = 6.66$). Groups did not differ regarding gender, $\chi^2(2)=4.318$, $p=.115$, but there was a significant group difference with regards to age, $F(2, 193)=3.412$, $p=.035$.

—Insert Figure 2 here—

Assessment measures

Lifetime exposure to print. The ART-G (Mar & Rain, 2015; see Study 1) was used to categorize participants as either fiction experts, non-fiction experts, or infrequent readers. Fiction experts were considered individuals with an above-average score on the fiction subscale of the ART-G (defined as being more than 1 *SD* above the population mean) and a preference for fiction over non-fiction on the ART-G. Non-fiction experts were considered participants with an above-average score on the non-fiction subscale of the ART-G (again defined as being more than 1*SD* above the population mean) and a preference for non-fiction over fiction on the ART-G. Infrequent readers were considered individuals scoring below average on both ART-G subscales (scores were regarded as below average if they were below the population mean). Population means and *SDs* were determined a priori in a sample of $N=826$ participants. These respondents constituted the participants of three previous online studies during which respondents completed the ART-G. In this sample, the ART-G fiction subscale had a mean of 16.83 ($SD=15.88$), the ART-G non-fiction subscale had mean of 3.89 ($SD=4.18$). To determine (non-)fiction preference, scores on the fiction and the non-fiction subscales were *Z*-standardized. If the *Z*-standardized fiction subscale was greater than the *Z*-standardized non-fiction subscale, participants were thought to have a preference for fiction over non-fiction. If the *Z*-standardized non-fiction subscale was greater than the *Z*-

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standardized fiction subscale, participants were thought to have a preference for non-fiction over fiction.

Trait empathy. The EQ (Baron-Cohen & Wheelwright, 2004) served as an indicator of trait empathy as in Study 1. Cronbach's α in the current sample was .89.

ToM. Items of the Strange Stories task (Happé, 1994; White, Hill, Happé, & Frith, 2009) were used to assess ToM. This task has been shown to reflect advanced mentalizing ability in children and adults (overview: White et al., 2009). Participants are presented with short vignettes and are asked to explain a character's behaviour/things happening to a character. Hence, participants need to attribute mental states such as desires, beliefs or intentions, and sometimes higher order mental states, in order to solve the task. We used eight stories about mental states to measure ToM; eight stories about physical processes were implemented to control for comprehension difficulties unspecific to ToM. Stories appeared in a different random order for each participant. The scoring criteria reported in White et al. (2009) were applied. Hence, correct responses were coded '2', partly correct responses were coded '1', and incorrect responses were coded '0'. Separate sum scores for the mental state and the physical stories were created by adding up scores achieved in the two types of stories, each with a possible range of 0 to 16. The author coded all responses, while a second rater independently double-coded a random selection comprising twenty percent of all responses to test inter-rater reliability in terms of the AC1 coefficient (Gwet, 2001, 2008). In the present sample, coefficients were .97 for the category '2', .60 for the category '1', and .69 for the category '0'.

General knowledge. An adapted version of the vocabulary subtest of the Wechsler Abbreviated Scale of Intelligence – Second Edition (WASI-II; Wechsler, 2011) reflected participants' general knowledge, as this subtest measures semantic knowledge, verbal comprehension and expression. Respondents had to provide a written definition of 31 words

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presented to them. The time limit for each word was 30s. Correct responses were awarded a score of '2', partly correct responses were coded '1', and incorrect responses received a score of '0'. A sum score with a possible range of 0 to 62 served as dependent measure.

Imaginability. We applied an imaginability task introduced by Hassabis, Kumaran and Maguire (2007). Participants were asked to imagine themselves in three different fictitious situations, such as lying on a tropical beach, and verbally described as many sensory perceptions as possible when imagining each scene, by typing their response into an open text box. Subsequently participants rated how easy this task was by responding to five items (two of them negatively worded, e.g., "How difficult did you find this task?") on a five-point rating scale, and by selecting apt statements from twelve utterances, four of them inversely phrased (e.g., "It wasn't a scene you could step into; it wasn't really joined-up"). Two sum scores, calculated across all stories after reverting inverse items, indicated imaginability, one of them composed of the rating scale items (possible range: 15 to 75), the other one composed of the multiple-choice questions (possible range: -12 to 24).

Creativity. A Remote Associates Test (RAT; Mednick, 1962) provided an indicator of creativity, in particular its convergent thinking component (Lee, Huggins, & Therriault, 2014). Participants were presented with 25 triplets of words that at first glance seem to be unrelated, e.g. room – blood – salts. Participants were to find a fourth word that relates to each of the three words (solution for the exemplary triplet: bath). Since Marko, Michalko, and Riečanský (2019) recommended setting a time limit of 25s to solve each triplet, in the present experiment respondents had 10 minutes to complete the entire test before the Qualtrics survey automatically progressed. A sum score with a possible range of 0 to 25 was achieved by adding up the number of accurately solved items.

Procedure

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Respondents completed the study online, via the Qualtrics platform. After providing informed consent, participants administered the assessment tasks in the following order: vocabulary test, imaginability task, RAT, EQ, Strange Stories task, ART-G. Finally, they provided their demographics, were debriefed in written form, and reimbursed. Completion took approximately 90min.

Data analysis

Analyses were pre-registered, and the full datasets are available on the Open Science Framework web pages (see https://osf.io/9dukr/?view_only=5756db587448412e8d196a062d6e3a2f).

Each dependent measure was analyzed separately using one-way ANOVAs that included the between-subjects factor group (fiction experts vs non-fiction experts vs infrequent readers). For the Strange Stories task, the score of the physical stories was included as covariate. Simple planned contrasts were implemented in which fiction experts served as a reference group for all outcomes except the vocabulary test, where infrequent readers constituted the reference group.

Results

Descriptive statistics for the dependent measure in each assessment task are summarized in Table 2, and the key effects are plotted in Figure 3. Seventy four missing values (i.e. 0.55%) for the EQ were replaced with the series mean (i.e., the sample mean of the respective item). There were no further missing values.

Notably, the overall sample was more diverse regarding age and lifetime exposure to fiction ($M_{age} = 59.72$, $SD = 7.07$; M ART-G fiction sub-scale score = 30.56, $SD = 20.06$) compared to the sample in Study 1 ($M_{age} = 20.09$, $SD = 2.98$; M ART-G fiction sub-scale

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score = 6.11, $SD = 8.24$). Study 2's sample also had a more balanced gender distribution than Study 1 (64.3% vs 82.7% females, respectively). Preliminary analyses confirmed that accuracy in the mental stories sub-score of the Strange Stories task ($M=13.56$ given a possible range of 0 to 16) and the vocabulary test ($M=47.61$ given a potential range of 0 to 62) was good. In addition, the average accuracy rate for the RAT was 33.28% ($M=8.32$ given a potential range of 0 to 25), which indicated that items were of medium difficulty for the present sample (Bowden & Jung-Beeman, 2003).

Between-group differences were tested separately for each assessment task (and subscale, where appropriate) using one-way ANOVAs, as described above (see Table 2). These failed to show any significant differences between the three groups for trait empathy, ToM, or imaginability ($ps \geq .06$), however, a significant main effect of group emerged for the vocabulary subtest and RAT ($ps < .00001$). In line with our predictions on these measures, group comparisons showed that infrequent readers had inferior general knowledge compared to both fiction experts (contrast estimate=9.63, $SE=1.09$, $p < .001$) and non-fiction experts (contrast estimate=9.29, $SE=1.16$, $p < .001$), which suggests that general exposure to text enhances world knowledge. In the RAT, group comparisons showed that fiction experts had superior creativity performance compared to both infrequent readers (contrast estimate=-2.57, $SE=.88$, $p=.010$) and non-fiction experts (contrast estimate=-4.63, $SE=.90$, $p < .001$), which suggests that exposure to specifically fictional texts is associated with improvements in creativity.

—Insert Table 2 here—

—Insert Figure 3 here—

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To control for age differences between the three groups (see participants section), we ran exploratory analyses (not pre-registered since these age differences could not have been predicted) that replicated the analyses described above but with age-corrected dependent measures. Correction was achieved by regressing each outcome variable on age; the resulting standardized residual served as the age-corrected indicator in each ANOVA. For the Strange Stories task, the mental stories score was additionally regressed on the physical stories score so that no covariate had to be included in the age-corrected analyses. Results replicated those in the pre-registered analysis, showing no significant differences between the three groups for trait empathy, ToM, or imaginability ($p \geq .06$), but a significant main effect of group for the vocabulary subtest and RAT ($p < .001$).

Finally, following our pre-registration, exploratory correlational analyses were run across the full sample ($N=306$) to investigate associations between the ART-G fiction subscore and all dependent measures (see Table 3). As distinct from the ANOVAs reported above, these correlations additionally included data of participants who did not meet the criteria to be categorized in one of the three groups. The significance level for each test was corrected for the 6 correlations using the Bonferroni correction ($p_{\text{crit}} = .0083$). Bivariate correlations supported the findings observed in the ANOVAs in so far as the vocabulary subtest and the RAT were significantly positively related to the ART-G fiction subscore ($p < .00001$). Furthermore, a significant positive correlation emerged with the mental stories subscore of the Strange Stories task ($p = .002$). However, when partial correlations controlling for the ART-G non-fiction subscale were run (suggested by a significant correlation between both ART-G sub-scales, $r = .705$, $p < .001$), the correlation with the Strange Stories task became insignificant ($p = .013$), while the significant relationships with the vocabulary subtest and RAT were preserved (see Table 3).

—Insert Table 3 here—

Discussion

In Study 2 we adopted a well-powered, pre-registered approach that improved on the design of Study 1 in three different ways: The ‘signal’, i.e., the variance of the independent variable, was maximized, firstly, through between-group comparisons contrasting fiction experts with non-fiction experts and infrequent readers. Secondly, participants were recruited from an older age group, i.e. 50- to 80-year-olds. Thirdly, a broader range of outcome variables that may benefit from frequent exposure to fiction was taken into account. This was achieved by considering general knowledge and imaginative capacities in terms of imaginability and creativity in addition to social cognition.

The hypothesis based on previous studies, that fiction experts would possess enhanced empathy and ToM abilities compared to non-fiction experts and infrequent readers, was again not supported; our analyses failed to detect group differences in empathy or ToM. As in Study 1, no significant correlation was found between lifetime fiction exposure and empathy, and although a small to medium-sized correlation emerged between the ART-G fiction subscale and the mental stories subscore of the Strange Stories task, this relationship was no longer significant when exposure to non-fiction was controlled for. This finding suggests that any beneficial effect of reading on ToM is not specific to reading fiction. In contrast to Study 1, the non-significant effect of expertise cannot be explained by insufficient variation in fiction exposure, therefore Study 2 strongly contradicts Mumper and Gerrig (2017)’s meta-analysis which showed a positive association between fiction reading and social cognition, even after controlling for non-fiction reading. We appreciate that our study, albeit well-powered for detecting medium-size effects, lacked the power to pick up on small effects.

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However, this raises the question how small an effect may be for it to still have practical relevance.

Similarly, the present results failed to find evidence that fiction experts outperform non-fiction experts and infrequent readers regarding imaginability. Neither the between-group ANOVAs nor correlational analyses indicated a relationship between fiction expertise and the two dependent measures of the imaginability task. Interestingly, our statistical analyses provided converging evidence for the prediction that fiction experts are superior with regards to creativity. At first glance, this pattern of results conflicts with the widespread notion that an enhancement of creativity depends on a preceding increase of imaginability (e.g., Pelapat & Cole, 2011). This apparent inconsistency can be resolved if one assumes that fiction experts are not equipped with more advanced imaginative capacities per se than non-fiction experts and infrequent readers, but that they are superior in harnessing products of imagination for creative thinking processes, in particular, the convergent thinking component assessed by the RAT. In other words, fiction experts may be better able than both control groups to utilize their imagination for generating creative solutions. This assumption deserves targeted examination. For instance, future investigations should consider the time course in which different imagination-related skills are affected by reading fiction.

Finally, the present results supported the prediction that both fiction and non-fiction experts would score higher regarding general knowledge than infrequent readers. Across all types of statistical tests, i.e. between-group comparisons and correlational analyses, lifetime reading of fiction and non-fiction was positively linked with general knowledge. However, it should be borne in mind that general knowledge was assessed via a vocabulary test indicating crystallized verbal intelligence. It may seem rather obvious that frequent reading of fiction or non-fiction improves one's vocabulary. Thus, strictly speaking, the present results regarding the vocabulary test can be regarded as a sanity check in the sense that they demonstrate that

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the participants categorized as fiction and non-fiction experts have actually engaged in a considerable amount of reading. However, these findings go beyond basic vocabulary and in fact address improved knowledge about the world since “the knowledge of a word not only implies a definition, but also implies how that word fits into the world” (Stahl, 2005, p. 95). Nevertheless, further empirical work would be desirable to investigate fiction-based effects on knowledge using a wider variety of knowledge tests.

General Discussion

In the present article we reported two studies investigating correlates of lifetime exposure to written fiction. Study 1 employed a correlational design in a young adult sample, and assessed outcomes in terms of social and moral cognition using a novel battery of self-report, behavioural, and implicit indicators. Study 2 adopted a cross-sectional design and a broader scope both in terms of sampling and outcome variables by comparing older adult fiction experts with non-fiction experts and infrequent readers regarding general knowledge, imaginability, and creativity, in addition to social cognition.

Both studies failed to detect a relationship between lifetime exposure to print fiction and general social cognition, in terms of empathy and ToM. This finding contradicts theories that have postulated that frequent reading of fictional narratives over an extended period of time leads to gains in social cognitive abilities (e.g. Mar, 2018a; Mar & Oatley, 2008). However, the present results do not rule out the possibility that reading fiction has some benefits for social cognition; for instance, it is possible that reading narrative fiction affects specific aspects of our social and moral cognition, e.g., by influencing our empathy and moral attitudes toward particular groups of people, namely those portrayed in the particular fictional texts one reads. The current assessment measures, which operationalized social cognition in a rather general sense, would not have been sensitive to this sort of impact. Such specific

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effects of reading fictional narratives on morality have been observed in previous experimental studies. For example, stories about animals that failed to raise participants' general concern for animal welfare have nevertheless been found to increase their concern for the welfare of the species depicted in those narratives (Małecki, Sorokowski, Pawłowski, & Cieński, 2019). Yet, even if this more specific type of fiction-related benefit for social cognition exists, the models proposed by Mar and Oatley (2008) and Mar (2018a) would need revising. Firstly, their claims are about fiction-based improvement of general social cognitive skills, and secondly because the present pattern of results suggests that social cognition is not the outcome area most strongly affected by reading fictional narratives. Study 2 revealed an advantage with regards to general knowledge on a vocabulary test (although this pertained to the non-fiction experts as well) and creativity on a RAT. A revised theory of psychological effects of written fiction needs to consider these results. The pattern of findings also suggests that reading fiction impacts on multiple psychological outcomes, i.e., not just on a single area such as social cognition, and highlights the need to develop an integrative framework for fiction. Consoli (2018) has taken a promising step in this direction by developing a theory that incorporates different strands of fiction research within psychology, such as social, cognitive, and media psychology, communication science, cognitive neuroscience, and experimental aesthetics.

Although, as outlined above, the two studies presented here have made novel contributions to the field in several respects, a number of limitations need to be acknowledged. First, the correlational/cross-sectional design of both studies prevents us from drawing certain conclusions about causal influences between the variables under investigation. More precisely, if frequent reading of fiction over an extended period of time genuinely caused improvements of social cognition, this would become manifest in terms of a significant positive correlation between fiction reading and social cognition. Hence, a

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positive association between these variables can be considered a necessary condition of a causal relation. This also means that an absence of a positive correlation rules out a linear causal relationship between the two variables, in this case between fiction reading and general social cognitive abilities. However, the inversion of this argument is not plausible, that is, one cannot infer from a positive correlation between, for instance, fiction reading and creativity, a causal relationship between the two variables, for instance that reading fiction causes enhancements of creativity. Such a positive correlation could also be explained by a causal influence of the opposite direction, or by a third variable causing increases in the two associated variables. Consequently, the positive correlation between fiction reading and creativity could be a result of multiple influences, for example highly creative individuals being more attracted to written fiction than individuals with lower creative abilities.

Similarly, the positive association between reading fiction and general knowledge in the vocabulary test could trace back to people with higher knowledge reading more fiction than people with lower knowledge. Resonating with this view, vocabulary test performance has been found to predict reading comprehension (e.g. Laufer & Aviad–Levitzky, 2017; Ouellette, 2006). Alternatively, a third variable not considered here, such as openness to experience, could have caused increases of both reading fiction and creativity (and general knowledge as well), without a direct causal relation between the variables under investigation.

Only rigorous experimental designs where the researcher actively manipulates the independent variables while controlling confounding variables permit causal inferences. However, such an approach is difficult, if not impossible to realize for the current research question. If we follow Mar (2018b) in assuming that fictional narratives exert their influence as a result of frequent engagement over extensive periods of time, an experimental design would require that participants are randomly assigned to spend a certain amount of time

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either reading fiction or non-fiction or nothing at all over years or even decades. This is hard to implement, if only for ethical reasons. As an alternative approach, future research could track participants, preferably starting at a young age, using ambulatory assessment with regards to fiction and non-fiction exposure, other school/professional and leisure activities, and outcomes such as creativity and general knowledge, over several years. This could help reveal the order in which these variables change over time, for example whether an increase in fiction exposure precedes an increase in general knowledge or vice versa, which in turn could help identify the direction in which these variables influence each other.

Conclusions

Two studies consistently failed to find evidence that lifetime exposure to print fiction is related to superior general social cognitive abilities in two areas: empathy and ToM. This pattern conflicts with results of a meta-analysis by Mumper and Gerrig (2017) and with models of the relationship between fictions/narratives and social cognition, namely the simulation model (Mar & Oatley, 2008) and the SPaCEN framework (Mar, 2018a). However, Study 2 revealed that fiction experts outperform both non-fiction experts and infrequent readers in creativity, in particular its convergent thinking component. Thus, conclusions drawn based on earlier work, assuming that reading in general is associated with heightened levels of creativity (Kelly & Kneipp, 2009; Mourgues, Preiss, & Grigorenko, 2014), may have to be refined to specify effects of fiction reading. Furthermore, fiction and non-fiction experts exhibited enhanced general knowledge on a vocabulary test compared to infrequent readers. While previous research has shown that readers integrate false information from fictional texts into their general world knowledge (Appel & Richter, 2007; Butler, Dennis, & Marsh, 2012; Eslick, Fazio, & Marsh, 2011; Fazio, Barber, Rajaram, Ornstein, & Marsh, 2013; Gerrig & Prentice, 1991; Marsh & Fazio, 2006; Marsh, Meade, & Roediger, 2003;

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Prentice, Gerrig, & Bailis, 1997; Rapp, Hinze, Slaten, & Horton, 2014; Wheeler, Green, & Brock, 1999), the current research demonstrates that reading fiction over a lifetime is just as associated with improved general world knowledge as reading non-fiction. This suggests that the results of previous studies may have been an artifact of using experimentally manipulated texts as well as a failure to compare effects for fiction with non-fiction.

In sum, we identify several areas for future research: Contemporary models (Mar, 2018a; Mar & Oatley, 2008) that view enhancement of general social cognition to be at the core of effects of narrative fictions are not supported by the present results. If future research similarly fails to produce supporting evidence, these models may need to be revised. In particular, the current results suggest that an integrative theory of fiction-based effects should incorporate creativity and general world knowledge. Furthermore, fine-grained investigations of the sort of imaginative capacities benefitting from fiction consumption are desirable, especially concerning whether reading fiction leads to a more efficient use of imagination for creative problem-solving, without a preceding increase in imaginability. Finally we encourage longitudinal observations of the time course in which fiction consumption and potential outcomes change in order to better understand the direction of influence between these variables.

Acknowledgments

This work was supported by the Leverhulme Trust under Grant RPG- 2017-365. We would like to thank David Cowan, Wilhelm Hofmann, Raymond Mar, and Marco Perugini for providing their materials, as well as Francesca Barrett, Malgorzata Bialon, and Jacob Jeffrey for help with data collection and processing.

Declaration of Interest Statement

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The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest, in the subject matter or materials discussed in this manuscript.

Data Availability Statement

All data is openly available at
https://osf.io/ayh6v/?view_only=53c54e00351743a9a503b14b81ee4a85 (Study 1) and
https://osf.io/9dukr/?view_only=5756db587448412e8d196a062d6e3a2f (Study 2).

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CORRELATES OF LIFETIME EXPOSURE TO PRINT FICTION

Table 1. Study 1: Associations of lifetime exposure to fiction with measures of social cognition and morality. Note that $p_{crit} = .0038$.

| | | Association with ART-G fiction sub-score | | | | | |
|--|--|--|----------|---------------------------------|--|--|---|
| | | <i>M (SD)</i> | <i>n</i> | Pearson's <i>r</i> ^a | p-value of Pearson's <i>r</i> (two-tailed) | Partial correlation controlling for ART-G non-fiction sub-score ^a | p-value of partial correlation (two-tailed) |
| ART -G | Fiction sub-score | 6.11 (8.24) | 150 | | | | |
| | Non-fiction sub-score | 2.02 (2.27) | 150 | - | - | - | - |
| EQ | | 47.09 (11.26) | 150 | .069 | .399 | .173 | .220 |
| IRI | Fantasy | 19.59 (4.80) | 150 | .124 | .131 | .089 | .532 |
| | Perspective Taking | 19.54 (4.19) | 150 | .080 | .333 | .112 | .431 |
| | Empathic Concern | 20.73 (4.30) | 150 | .013 | .876 | .051 | .719 |
| | Personal Distress | 13.64 (4.31) | 150 | -.150 | .067 | -.036 | .798 |
| Pain task | Pain rating: Difference score (pain-no pain) | 23.31 (22.92) | 62 | .072 | .580 | -.214 | .128 |
| Eye-tracking task | Percentage dwell-time to eye region | .56 (.22) | 135 | .229 | .007 | .113 | .425 |
| | Difference average pupil size (sad-neutral) | 12.16 (101.04) | 135 | .076 | .383 | -.007 | .963 |
| | Sadness rating | 3.63 (1.03) | 139 | -.083 | .333 | .010 | .903 |
| | Arousal rating | 4.32 (.942) | 139 | .107 | .209 | .077 | .369 |
| RMET: Relative frequency of correct responses | | .74 (.12) | 146 | .051 | .540 | .202 | .151 |
| IAMS score | | 21.37 (29.81) | 145 | -.047 | .579 | -.010 | .901 |
| Implicit morality IAT: D6 | | .60 (.30) | 147 | -.119 | .152 | .062 | .661 |

Note. IAT = Implicit Association Test, EQ = Empathy Quotient, RMET = Reading the Mind in the Eyes Test – Revised; IAMS = Immediate affect towards moral stimuli; IRI = Interpersonal Reactivity Index; ^acorrelation with IAMS score additionally controlled for Immediate Affect Towards Control Stimuli (IACS) score

CORRELATES OF LIFETIME EXPOSURE TO PRINT FICTION

Table 2. Study 2: Descriptive statistics for each dependent measure in each group, and ANOVA results for the main effect of group.

| Dependent measure | | Fiction experts | | Non-fiction experts | | Infrequent readers | | ANOVA: main effect of group | | | |
|-------------------------------|---------------------------------|-----------------|---------------|---------------------|---------------|--------------------|---------------|-----------------------------|----------------|----------------|------------|
| | | <i>n</i> | <i>M (SD)</i> | <i>n</i> | <i>M (SD)</i> | <i>n</i> | <i>M (SD)</i> | <i>df</i> | <i>F value</i> | <i>p value</i> | η^2_p |
| Empathy Quotient | | 66 | 44.56 (12.89) | 53 | 44.51 (13.81) | 77 | 44.80 (12.29) | 2, 193 | .009 | .991 | .000 |
| Strange | Mental stories sub score | 66 | 13.94 (1.83) | 53 | 13.87 (1.57) | 77 | 13.02 (2.05) | 2, 192 | 2.087 | .127 | .021 |
| Stories Task | Physical stories sub score | 66 | 13.20 (2.33) | 53 | 13.28 (1.81) | 77 | 12.14 (2.10) | - | - | - | - |
| Vocabulary test | | 66 | 51.48 (4.25) | 53 | 51.15 (6.41) | 77 | 41.86 (7.93) | 2, 193 | 50.177 | <.00001 | .342 |
| Imaginability | Rating scales score | 66 | 49.68 (6.93) | 53 | 51.58 (7.05) | 77 | 50.88 (8.58) | 2, 193 | .959 | .385 | .010 |
| task | Multiple-choice questions score | 66 | 11.08 (6.51) | 53 | 13.23 (6.16) | 77 | 10.52 (6.75) | 2, 193 | 2.862 | .060 | .029 |
| Remote Associates Test | | 66 | 10.83 (5.18) | 53 | 8.26 (5.26) | 77 | 6.21 (5.52) | 2, 193 | 13.340 | <.00001 | .121 |

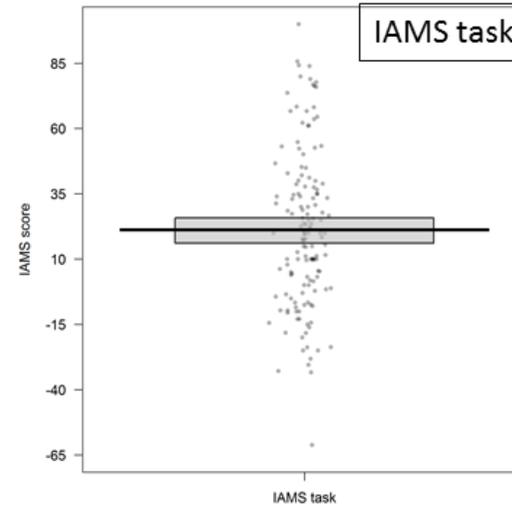
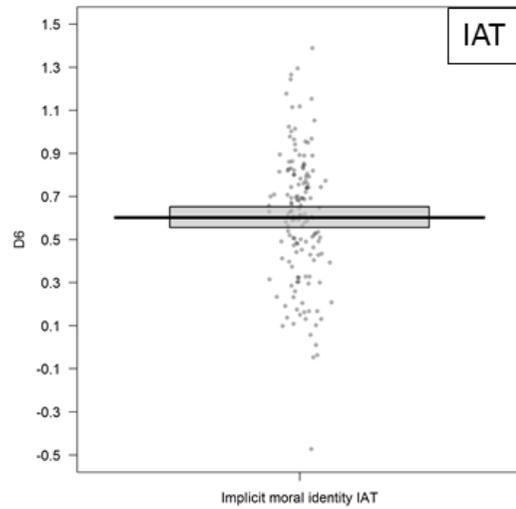
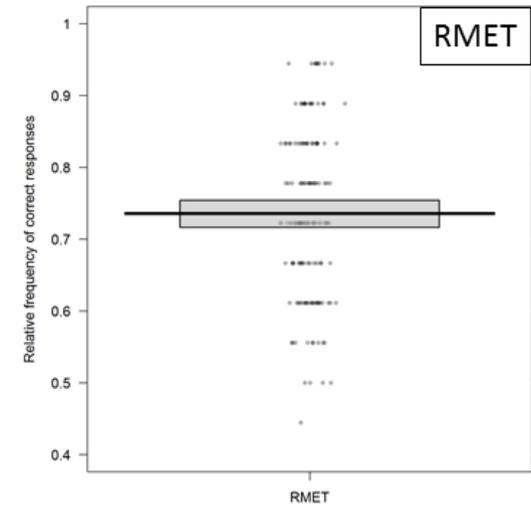
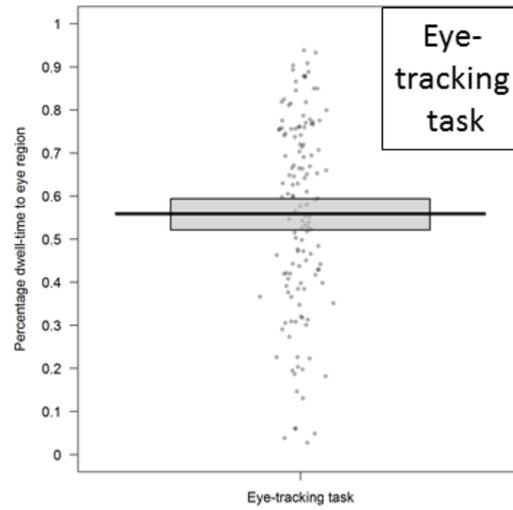
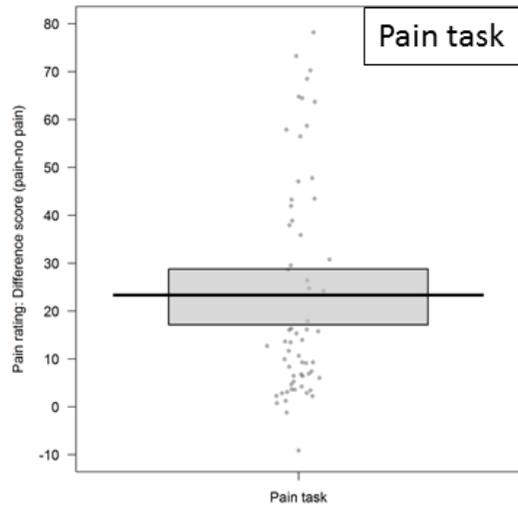
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Table 3. Study 2: Associations of lifetime exposure to fiction with all outcome measures.

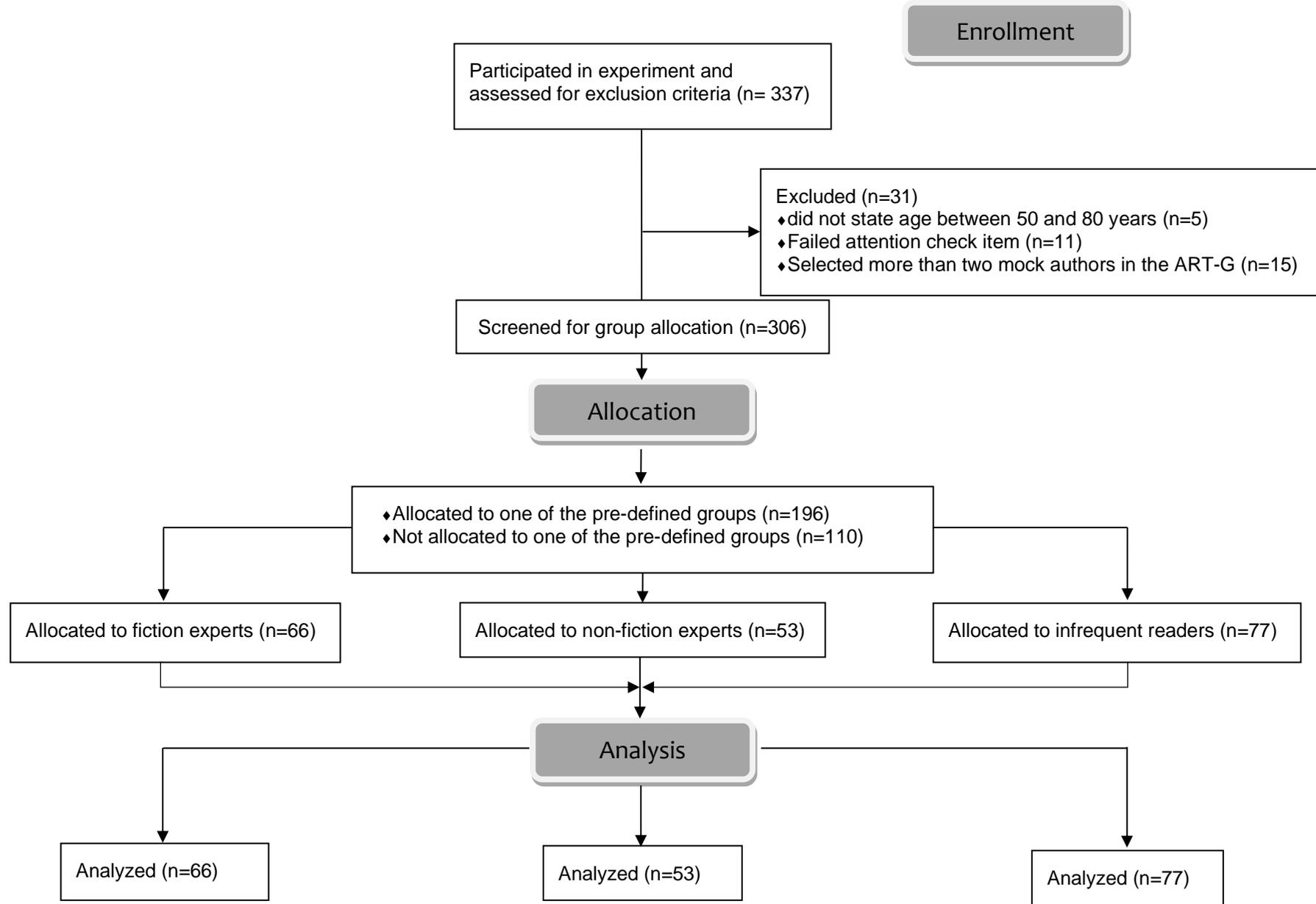
| | | Association with ART-G fiction sub-score | | | | |
|-------------------------------|---------------------------------|--|-----------|--------------------|---------------------|--------------------|
| | | | | <i>p</i> -value of | Partial correlation | <i>p</i> -value of |
| | | | Pearson's | Pearson's <i>r</i> | controlling for | partial |
| | | <i>n</i> | <i>r</i> | (two-tailed) | ART-G non-fiction | correlation |
| | | | | | sub-score | (two-tailed) |
| Empathy Quotient | | 306 | -.048 | .400 | -.039 | .503 |
| Strange Stories task | Mental stories sub-score | 306 | .175 | .002 | .142 | .013 |
| Vocabulary test | | 306 | .495 | <.00001 | .345 | <.00001 |
| Imaginability task | Rating scales score | 306 | -.077 | .180 | -.108 | .059 |
| | Multiple-choice questions score | 306 | .050 | .388 | -.017 | .766 |
| Remote Associates Test | | 306 | .257 | <.00001 | .242 | <.0001 |

Note. Coefficients for the Strange Stories task additionally controlled for physical stories sub-score.

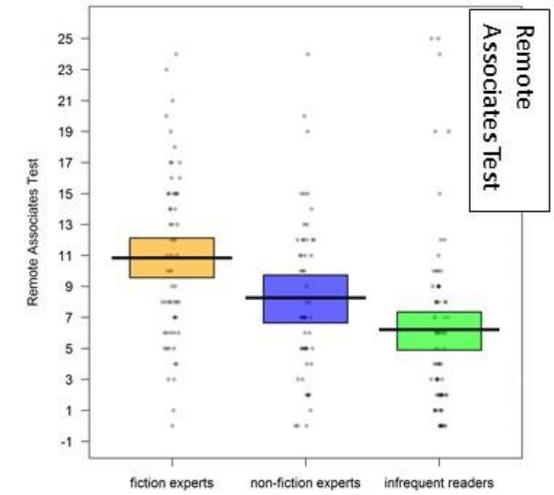
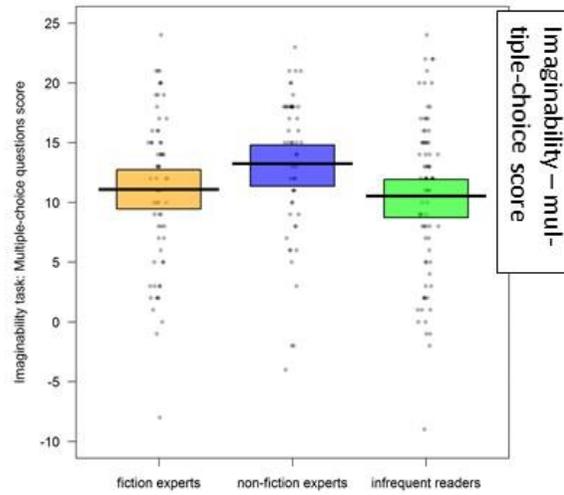
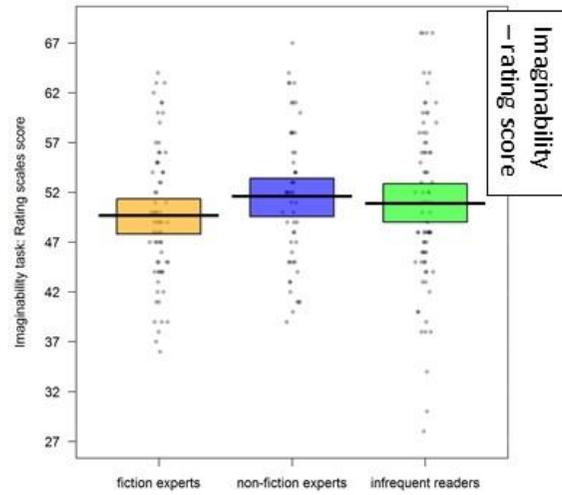
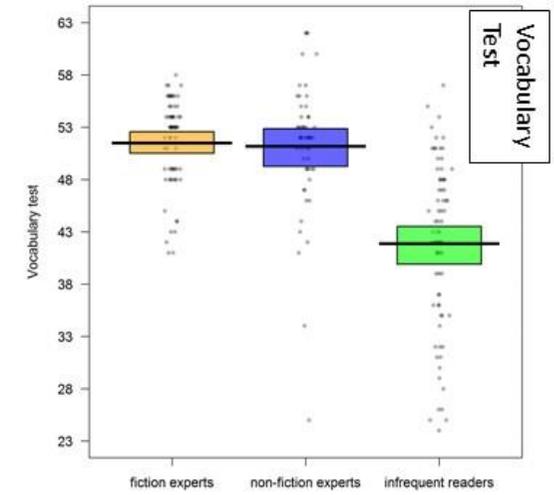
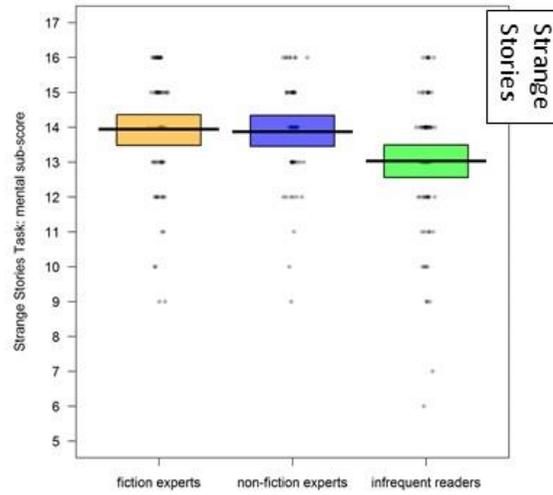
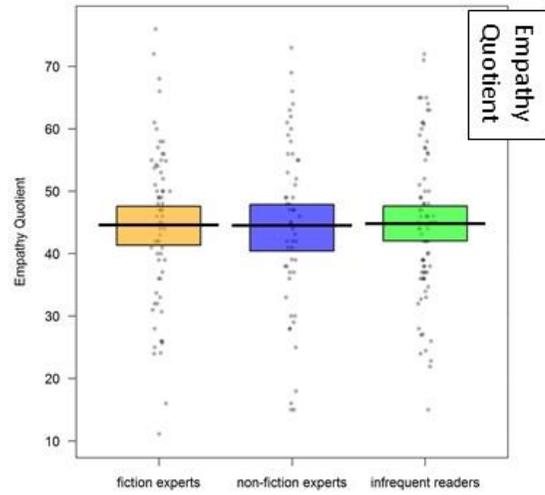
CORRELATES OF LIFETIME EXPOSURE TO PRINT FICTION



CORRELATES OF LIFETIME EXPOSURE TO PRINT FICTION



CORRELATES OF LIFETIME EXPOSURE TO PRINT FICTION



CORRELATES OF LIFETIME EXPOSURE TO PRINT FICTION

Figure captions

Figure 1. Pirate plots for main outcomes of Study 1.

Figure 2. Flow of participants through Study 2.

Figure 3. Pirate plots for main outcomes of Study 2.