Executive Function and Social Behaviour: Causal Evidence from Loading Working Memory and Inhibitory Control

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Pre-registration links:
https://osf.io/2qf6e/?view_only=9a4ed234fc9945de9f691d48975f5f39 (Experiment 1)
https://osf.io/3fkh8/?view_only=982fdd4ca3d84feeb55651271c04a02d (Experiment 2)

**Abstract**

This paper investigates how domain-specific executive functions contribute to perspective-taking and prosocial behaviour. Across two pre-registered experiments, we independently manipulated working memory (WM) and inhibitory control (IC) to assess their effects on social cognition. In Experiment 1 (N = 128), working memory load was varied using a dual-task paradigm, and participants completed behavioural and eye-tracking measures of perspective-taking and prosociality. WM load impaired perspective-taking, and this effect was larger under non-social than social load. Conversely, individual differences in prosocial behaviour were associated with higher social (but not non-social) WM capacity and larger support cliques, suggesting that dissociable cognitive mechanisms underpin different social outcomes. Notably, WM performance did not vary across social *versus* non-social conditions, indicating that increased social complexity did not impair WM, and that the relationship is not bidirectional. In Experiment 2 (N = 122), IC was manipulated using an ego-depletion task, but no significant effects of load emerged. We discuss the challenges of isolating IC from WM and highlight the need for improved methods in future research. Overall, these findings provide causal evidence linking WM to social skills, underscore the importance of distinguishing between social and non-social domains of executive functioning, and point to key conceptual and methodological priorities for the field.

Key words: Prosocial behaviour, working memory, inhibitory control, perspective-taking, social network

## Public Significance Statement

This research explored how different mental abilities, like storing information and controlling impulses, affect social behaviour. We found that when people had to multitask and use a lot of cognitive effort, they struggled more to imagine another person's perspective. In contrast, those with stronger memory skills for social information were more likely to behave kindly toward others. We also found that people with larger close support networks tended to be more helpful. However, we did not find strong evidence that impulse control directly influenced helping behaviour. We discuss possible reasons for this, including limitations in our methods, and suggest directions for future studies. Overall, our findings show that different mental abilities support different social behaviours and that close social networks may play a key role in shaping how people respond to others.

## 1. Introduction

A growing body of research suggests that executive function skills- particularly working memory (WM) and inhibitory control (IC)- are critical for supporting social abilities, such as perspective-taking and prosocial behaviour (e.g. Cane, et al., 2017; Fennis, 2011; Meyer & Lieberman; 2016; Mitkidis et al., 2022; Qureshi, et al., 2010; Xu et al., 2012). Perspective-taking refers to the capacity to adopt another person's visual or mental viewpoint (Happe et al., 1994; Samson et al., 2010), while prosocial behaviour encompasses voluntary actions that are intended to help or benefit others (Bergin et al., 2003; Crone, 2022). These social skills are closely linked- people who are better able to overcome egocentric bias and consider others' perspectives tend to engage more readily in prosocial behaviours, such as helping or sharing (Hinnant & O'Brien, 2007; Shih et al., 2009; Tamnes et al., 2018; Vescio et al., 2003). Importantly, both perspective-taking and prosociality rely on executive processes: representing and shifting between self and other perspectives (WM) and suppressing one's own viewpoint to adopt another's (IC; Diamond, 2013; Jensen, 2016). Despite strong theoretical links (e.g. Apperly & Butterfill, 2009; Carlson & Moses, 2001; Miyake et al., 2000), the causal mechanisms underlying executive functions' influence on social behaviour remain unclear. In this paper, we test whether taxing WM or IC impairs perspective-taking and prosocial behaviour, to better understand the causal role of executive functions in social performance.

Several studies have explored the role of WM and IC in perspective-taking, providing evidence to support a relationship via parallel developmental trajectories (Carlson et al., 2004; De Lillo & Ferguson, 2023; Perner & Lang, 1999; Symeonidou et al., 2016), overlapping neural correlates (Dumontheil, 2016; Healey & Grossman, 2018), individual differences (Brown-Schmidt, 2009; Bradford et al., 2015, 2022; Yuan et al., 2022;), and cognitive training interventions (Meyer & Lieberman, 2016; Santiesteban et al., 2012). Much less is known about how WM and IC contribute to prosocial behaviour, with only limited support from correlational and training studies (Barzy et al., 2025; McQuade et al., 2013; Traverso et al., 2020; de Wilde et al., 2016; Li et al., 2021; Wardlow, 2013). A common approach to test the causal role of executive functions is the dual-task paradigm, in which participants perform a secondary task that loads cognitive resources while completing a social task. This method is based on the premise that the human cognitive system has limited processing capacity. When two tasks are performed concurrently, they compete for shared resources, such as WM or IC. If performance on the social task deteriorates under cognitive load, it suggests that the loaded function plays a critical role. Thus, dual-task interference can provide insights into the organisation and resource-dependence of social cognitive processes.

Existing dual-task research has shown that loading WM disrupts perspective-taking (Cane et al., 2017; Qureshi & Monk, 2018; Qureshi et al., 2010; He et al., 2024), however effects on prosocial behaviour are inconsistent. Some studies show that loading WM impairs cooperation and prosociality (Hiraoka & Nomura, 2016; Mitkidis et al., 2022; Zhao et al., 2024), and others show that this actually increases prosociality in certain contexts (e.g. promoting honesty under time pressure; Rand et al., 2012; Van't Veer et al., 2014). No studies have tested whether loading inhibitory control has a similar impact on perspective-taking or prosociality. One reason for this is that applying inhibitory load in a concurrent dual-task paradigm is challenging; inhibitory control is a reactive and transitive process which is not easily isolated on a trial-by-trial basis. Recently, however, researchers have used ego-depletion paradigms to explore whether global reductions in self-control resources reduce the tendency to behave prosocially. In these studies, tasks such as Stroop, stop-signal and emotional inhibition are used to deplete inhibitory resources before testing a social behaviour. Findings are mixed, with some showing that ego-depleted individuals behave less prosocially (Fennis, 2011; Nie et al., 2025; Ugur, 2021; Xu et al., 2012; Zha et al., 2025), and others failing to replicate these effects (Hagger et al., 2016; Hurley, 2023; Lurquin et al., 2016). In this paper, we report two experiments that load WM (via a concurrent dual-task) and IC (via inhibition depletion) to test the impact on participants' ability to take others' perspectives and engage in prosocial behaviour.

In addition, we distinguish between social and non-social domains of WM and IC demands to assess their differential effects. The majority of research that has examined associations between executive functions and social behaviour, or tested effects of dual-task load, has focused on non-social domains of cognition, and few studies have directly compared social and non-social executive demands. However, those that have tested effects in both social and non-social domains have indicated that socially-relevant executive processes may be uniquely engaged in interpersonal contexts. For example, training in social WM (e.g. personality traits for friends), but not cognitive WM (e.g. alphabetical order of names), leads to improvements in perspective-taking accuracy (Meyer & Lieberman, 2016;

Meyer et al., 2015), and neural responses related to social WM predict perspective-taking accuracy (Meyer et al., 2012, 2015). Similarly, training in social IC (imitation-inhibition task), but not cognitive IC, can improve perspective-taking in both adults and children (Kampis et al., 2023; Santiesteban et al., 2012). A recent cross-sectional study found that prosocial behaviour (participants' willingness to sacrifice time to help another person) was positively predicted by individual differences in cognitive WM and social IC, whereas social WM negatively predicted their self-reported prosociality (Barzy et al., 2025). Together, these effects highlight the need to further distinguish how different domains of executive shape social behaviour.

*The Current experiments*

In two pre-registered experiments, we directly tested the role of executive capacities in shaping social behaviour. Specifically, we examined whether loading working memory (Experiment 1) or depleting inhibitory control (Experiment 2) affected perspective-taking accuracy and prosocial behaviour tendencies. Each experiment employed a fully crossed design, manipulating both the load level (high *vs.* low) of a secondary task and the domain of executive demands (social *vs.* non-social). Both experiments adopted a between-subjects design to avoid asymmetric carryover effects, repetition-related demand characteristics in social judgments, and fatigue associated with repeated high-load conditions.

Perspective-taking was assessed using an eye-tracked version of the Referential Communication task (also known as the "Director" task; Keysar et al., 2000). Participants followed instructions from an on-screen avatar to move objects around a grid; on some trials they had to refer to this person's visual perspective to select the correct object (and not a competitor object in privileged view). This task has been used extensively as a measure of visual perspective-taking, with evidence suggesting that performance is linked with executive capacities (Cane et al., 2017; Brown-Schmidt, 2009; Lin et al., 2010). Prosocial behaviour was assessed using the Prosocial Effort Task (Contreras-Huerta et al., 2022) in which participants chose how much effort they wished to exert to earn rewards for themselves or an unknown other. Variations of this task have replicated its validity as a stable indicator of prosociality (e.g. Contreras-Huerta et al., 2023; Harris et al., 2023; Lockwood et al., 2017). To our knowledge, it has not been tested alongside executive function measures.

In Experiment 1, working memory was manipulated on a trial-by-trial basis in a dual-task design (as in Cane et al., 2017). High or low working memory load was applied by asking participants to encode and then recall five or two words, respectively, on each trial. Words were either social (e.g. ‘friendly’, ‘stubborn’) or non-social (e.g. ‘smooth’, ‘printed’). In Experiment 2, inhibitory control was depleted in a ten-minute block before each perspective-taking and prosocial task (Using a task similar to that of Wang et al. 2022). High or low inhibitory load was applied by manipulating the balance of trial types to be either 75% or 25% incongruent trials, respectively. Stimuli were either social (i.e. faces and gender words) or non-social (i.e. colour words in coloured ink).

Across both experiments, we predicted that perspective-taking and prosocial performance would be impaired under high *versus* low load. Specifically, in the perspective-taking task, we expected participants to make more errors and increase fixations on the competitor when under high *versus* low load. In the prosocial task, we expected participants to act less prosocially when under high *versus* low load, and that this effect of load would be greater when they were earning rewards for the other than self (i.e. a load x self/other interaction). We tested whether effects of load on perspective-taking and prosociality would be greater in the social *versus* non-social domain. In Experiment 1, we predicted that WM recall accuracy would be lower under high *versus* low load (particularly in the more complex social conditions: privileged perspective-taking trials and other prosocial trials; Cane et al., 2017), and in the social *versus* non-social domain. In Experiment 2, we predicted that IC performance would be worse (i.e. a larger Stroop effect) under high *versus* low load, and in the non-social *versus* social domain.

Finally, we included measures of participants' core social networks (sympathy group and support clique; Stiller & Dunbar, 2007) to examine whether individual differences in social network size modulate these executive and social function outcomes. Previous research has shown that characteristics of an individual's social network, such as its size, density, diversity, and the quality of friendships, correlate with social abilities such as perspective-taking and prosociality (Barzy et al., 2025; Stiller & Dunbar, 2007; Tong et al., 2011; van den Bos et al., 2018; Vitaro et al., 2009). Specifically, Stiller and Dunbar (2007) found that perspective-taking accuracy was associated with the size of their support clique (i.e. the number of people they rely on for help or advice during serious social or financial difficulties), but not their sympathy group (i.e. the number of people they share close personal bonds with and maintain contact with at least once a month). We tested the prediction that these would correlate positively with perspective-taking, prosociality, and cognitive capacities.

*Transparency and Openness*

All methodological procedures and analysis plans for both experiments were pre-registered on the Open Science Framework (OSF) prior to data collection: https://osf.io/2qf6e/?view_only=9a4ed234fc9945de9f691d48975f5f39 (Experiment 1) and https://osf.io/3fkh8/?view_only=982fdd4ca3d84feeb55651271c04a02d (Experiment 2). Full pre-registered analyses (exploratory analysis) are presented in the Supplementary Materials. We have documented our participant recruitment methods, data exclusion criteria, and all data manipulation techniques utilised. All measures are included on the OSF page, as well as the full dataset and the R scripts used for conducting data analysis: https://osf.io/zvbxp/?view_only=4b313ab9c5934b3199194993ce271d56. Statistical analyses were conducted in R Version 4.5.0. and final model structures are detailed in the analysis script on OSF.

## 2. Experiment 1

### Methods

*Participants*

A total of 140 participants (aged 17–54 years old) were recruited through the University of [Anonymised] Research Participation Scheme in exchange for course credit and/or a cash payment. Our pre-registration targeted a minimum of 30 participants per group, determined *a priori* and guided by prior work using comparable social and non-social WM manipulations, including training and dual-task paradigms examining perspective-taking and prosocial behaviour (e.g., Barzy et al., in press; Meyer et al., 2016; Santiesteban et al., 2012; Cane et al., 2017). Sample sizes in this literature typically range from approximately 24-32 participants per between-subject condition.

Twelve participants were excluded for not meeting the pre-registered inclusion criteria, based on performance thresholds: N= 5 excluded for achieving less than 10% accuracy in the listener perspective condition of the perspective-taking task, and N=7 excluded for scoring less than 50% accuracy on the WM task. This resulted in a final sample of 128 participants (see Table 1), which is eight participants more than our pre-registered target. This adjustment was necessary to ensure proper counterbalancing of participants across different lists and conditions (see the Experimental Tasks section for more details). Participants were randomly assigned to one of the four WM load groups, with the final sample equally split between the four groups (N=32 per group).

Table 1: Participant characteristics in Experiment 1 and Experiment 2 (mean values, with standard deviations in parenthesis where appropriate).

| | Experiment 1 | | | | Experiment 2 | | | |
|---|---|---|---|---|---|---|---|---|
| **Characteristics** | Non-social High | Non-social Low | Social High | Social Low | Non-social High | Non-social Low | Social High | Social Low |
| **N** | 32 | 32 | 32 | 32 | 30 | 30 | 32 | 32 |
| **Age (years) M (SD)** | 21.56 (6.81) | 20.19 (2.22) | 19.69 (1.69) | 20.25 (2.46) | 19.63 (1.77) | 20.10 (2.96) | 19.38 (1.60) | 20.83 (3.06) |
| **Gender (F:M:other)** | (29:3) | (23:6:3) | (27:4:1) | (24:6:2) | (23:7) | (21:9) | (28:4) | (26:4) |
| **Ethnicity (N)** | | | | | | | | |
| White | 20 | 16 | 15 | 21 | 12 | 12 | 9 | 10 |
| Mixed/multiple ethnic groups | 2 | 1 | - | - | 2 | 2 | 3 | 2 |
| Asian/British Asian | 7 | 10 | 7 | 6 | 8 | 7 | 6 | 10 |
| Black/African/Caribbean/Black British | 3 | 4 | 9 | 4 | 8 | 8 | 12 | 5 |
| Other ethnic group (including Arab) | - | 1 | 1 | 1 | - | 1 | 2 | 3 |

*Experimental tasks*

*Working memory:* WM was loaded using a dual-task design that operated on a trial-by-trial basis alongside the perspective-taking and prosocial tasks. The WM task was adapted from Legaz et al. (2023), and was designed to measure both social and non-social WM capacity. In this task, participants were shown a list of either social or non-social adjectives (e.g., "kind," "loyal" *vs*. "printed" "round"), which they had to memorise before completing a perspective-taking or prosocial task trial. There were two levels of load: in the low-load condition, participants encoded two adjectives (presented on the screen for 2000 ms); in the high-load condition, they encoded five adjectives (presented for 5000 ms). After each trial, participants were presented with a second list of adjectives. The number of words shown was fixed across first and second lists and the order of words within each list was randomized. Participants had to judge whether the second list of words matched the first list exactly in content by clicking on-screen 'Yes' or 'No' options using the mouse. In total, eight different word lists were created, two for each condition (high/low × social/non-social), to ensure that participants saw different lists of words alongside the perspective-taking and prosocial task.

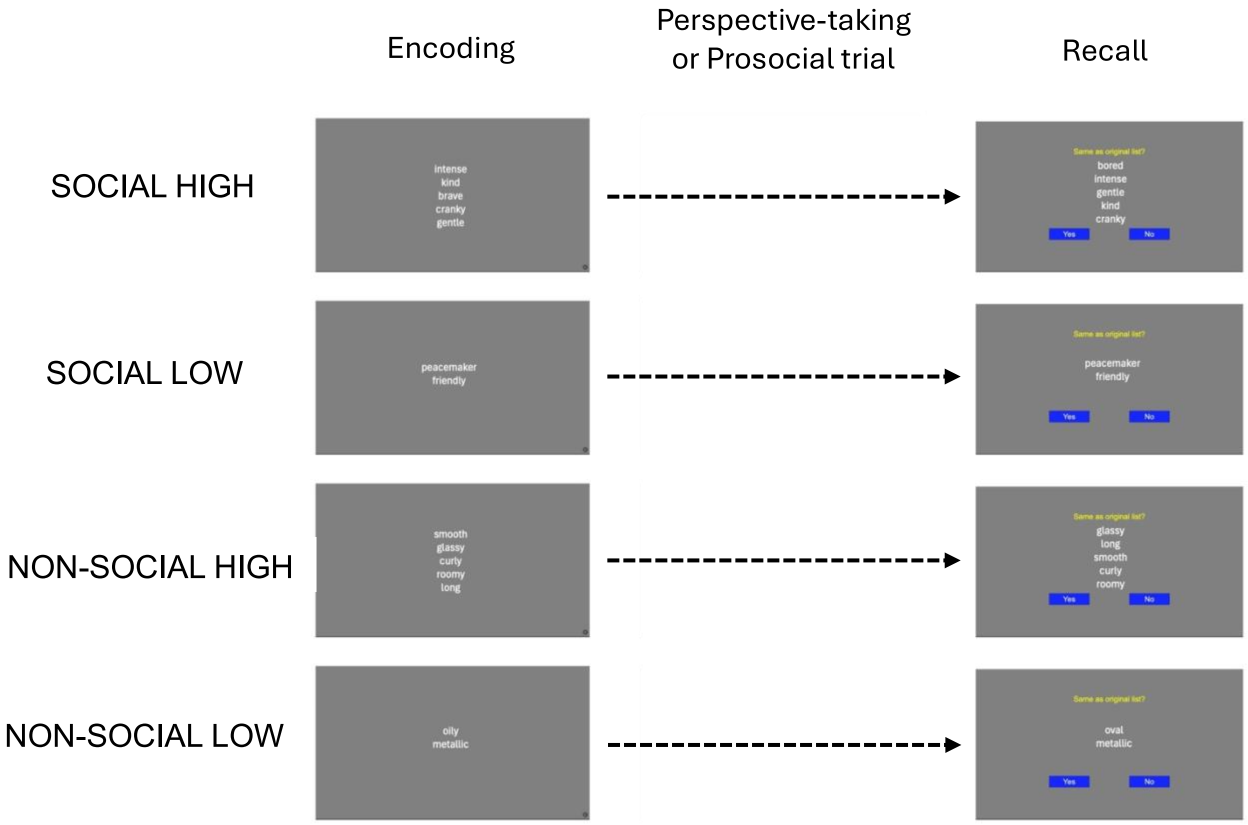


Figure 1. An example of the WM load trials for each condition, run concurrently with either the perspective-taking or prosocial task.

*Perspective-taking*: Perspective-taking was measured using an eye-tracked version of the Referential Communication task or the "Director" task (Keysar et al., 2000). In this task, participants followed the instructions of an on-screen "director" (represented by an avatar) to move objects within a 16-slot grid (see Figure 2). In each trial, eight objects were randomly placed in the grid, with two objects always occluded from the director's view by a green back. This indicated that the director could not see the contents of those slots. There were two conditions in the task: a shared perspective condition, where the target object was visible to both the participant and the director, and a listener perspective condition, where participants had access to an additional object (the competitor) that was not visible to the director. For example, in Figure 2, the director may say, "Move the small star one slot down". In the listener perspective condition (left image), the smallest star (i.e., the competitor) is only visible to the participant. To respond correctly, the participant must select the second smallest star (the target), which is visible to both of them, demonstrating perspective-taking by considering the director's limited viewpoint and ignoring the competitor object. In contrast, in the shared perspective condition (right image), the competitor was replaced with a neutral object that could not be mistaken for the target, reducing ambiguity.

Participants received detailed instructions before beginning the task. The task was programmed and run using SR Research Experiment Builder (Version 2.4.193), and the director's instructions were delivered via headphones. The task included two practice trials, followed by 12 experimental trials in the listener perspective condition, and 12 trials in the shared perspective condition. Each trial also included a filler instruction which did not involve perspective-taking (e.g. "Move the red hat one slot up"). Participants used the mouse to move the objects around the grid, and object selection accuracy and participants' eye movements were recorded throughout the task. Two versions of the perspective-taking task were created within each of the four WM load conditions to counterbalance the target and competitor objects (i.e., List 1 used the "small star" as the target and List 2 used the "large star"). When combined with the two word lists per load condition, this resulted in 16 counterbalanced stimulus lists (2 × 4 × 2), to which participants were randomly assigned, with approximately eight participants completing each list.

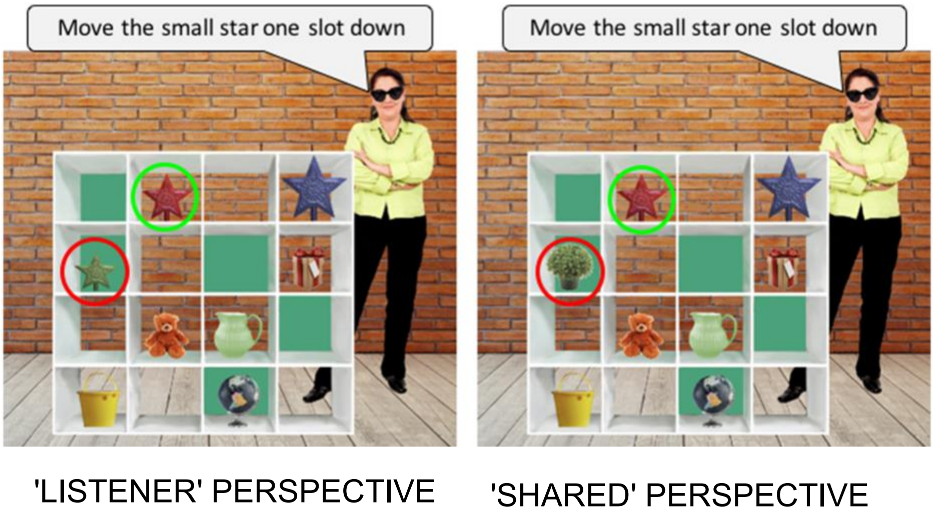


Figure 2. Example stimuli used in different perspective conditions of the Perspective Taking task.

*Prosociality:* Prosociality was assessed using the Prosocial Effort Task (Contreras-Huerta et al., 2022). In this task, participants decided how much effort they were willing to invest to earn real monetary rewards either for themselves or for an anonymous other person who also took part in the experiment (self/non-prosocial option *vs.* other/prosocial option). At the beginning of each trial, they were told who the credits would benefit. They then chose between two options: a 'work' option, which required varying levels of effort (30%, 60%, or 90%) to tick boxes on the screen and offered 2–4 credits (5p for each credit earned), or a 'rest' option, which required no effort and yielded just one credit (see Figure 3). Effort levels were based on the maximum number of boxes a participant could tick within 10 seconds. Prior to the main task, participants completed a calibration phase in which they had 10 seconds to tick as many boxes as possible (repeated three times, up to a maximum of 25 boxes). Their average performance during this phase was used to determine their individual effort thresholds for the task. During 'work' trials, participants had to tick all the required boxes within 10 seconds in order to earn the corresponding credits. Importantly, all trials lasted the same amount of time (10 seconds) regardless of the choice made, ensuring that decisions were not affected by time-based incentives. The remaining time for each trial was indicated by a 10-second countdown timer located at the bottom of the screen[1]. The location of the offers was counterbalanced, with 'work' and 'rest' options presented on both the left and right sides of the screen. Overall, there were four practice trials and 24 experimental trials (12 each in the 'self' beneficiary condition and 12 in the 'other' beneficiary condition).

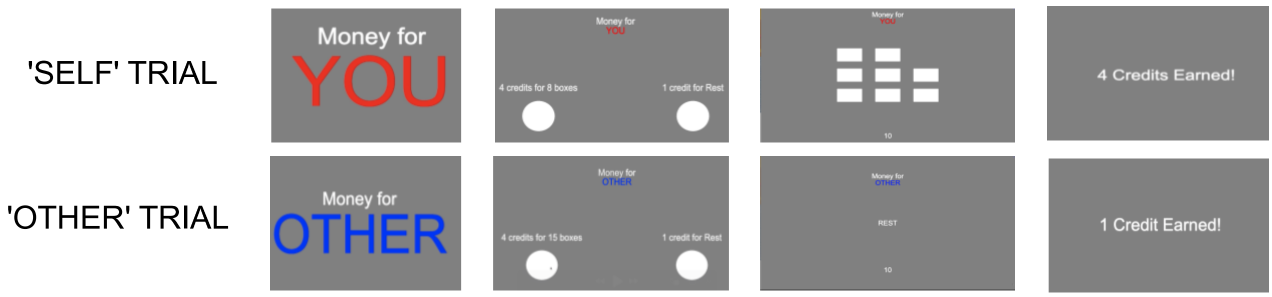


Figure 3. Example stimuli used in different beneficiary conditions of the Prosocial task.

*Social network questionnaire:* The size of participants' social network was measured using a questionnaire similar to the one by Roberts et al. (2008), originally based on the Dunbar and Spoors (1995) questionnaire, aimed at studying the two inner, most intimate layers of their social relationships: the support clique and the sympathy group. The support clique has been defined as "weekly contacts or best friends or intimates: those individuals from whom one would seek advice, support, or help in times of severe emotional or financial distress," and the sympathy group has been defined as "monthly contacts or the principal circle of friends, commonly defined as all those whose sudden death would be greatly upsetting." Participants were asked to 1. list all individuals with whom they had initiated contact during the week or

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[1] As in the original study, two precautionary measures were taken to ensure that participants remained attentive to the task. Participants were given 6 seconds to make their initial decision to choose either the 'work' or 'rest' option; failure to respond within this time resulted in earning zero credits for that trial, thereby encouraging engagement. In addition, the location of the offers was counterbalanced across trials, with options appearing on both the left and right sides of the screen.

month preceding the testing session, excluding work colleagues encountered in a professional setting (unless considered genuine friends), professionals (e.g., doctors, plumbers), and casual acquaintances (e.g., brief encounters in the street or at a bar). In addition to listing recent social contacts, participants were asked to identify which individuals were kin and which they would turn to for emotional support in the event of a major personal crisis (e.g., terminal illness, loss of a loved one, serious accident). Full item wording is available on OSF. Responses to items 1 and 3 were used to calculate two key social metrics: the support clique (typically 4–7 individuals from whom one seeks personal support in the event of a major personal crisis) and the sympathy group (typically 12–15 individuals contacted at least once a month). Prior research has demonstrated that this measure can reliably distinguish participants' core social groups from their broader social contacts (e.g., Dunbar & Spoors, 1997; Hill & Dunbar, 2003).

*Procedure*

The Psychology Research Ethics Committee at the [Anonymised] granted approval to conduct this experiment. All participants gave informed consent prior to taking part in the experiment. Participants completed all tasks in a single testing session in a quiet laboratory at the [Anonymised]. The demographics questionnaire (asking them about their age, gender and ethnicity) and social network questionnaire was always completed first, followed by the perspective-taking task and the prosocial task presented in a counterbalanced random order. Each testing session lasted between 45 minutes to one hour, including breaks when needed. The order in which participants completed the tasks, as well as the presentation of the word lists, was counterbalanced across the experiment.

During the perspective-taking task, participants viewed visual stimuli on a monitor positioned approximately 60cm cm from their eyes while listening to auditory instructions through headphones. Eye movements were recorded using an SR Research EyeLink 1000 Plus eye-tracker, sampling at 500Hz in remote mode. The standard 9-point calibration and validation procedure was completed at the start the task (and repeated as required), and drift correction was performed before each trial to ensure accurate gaze position throughout the session.

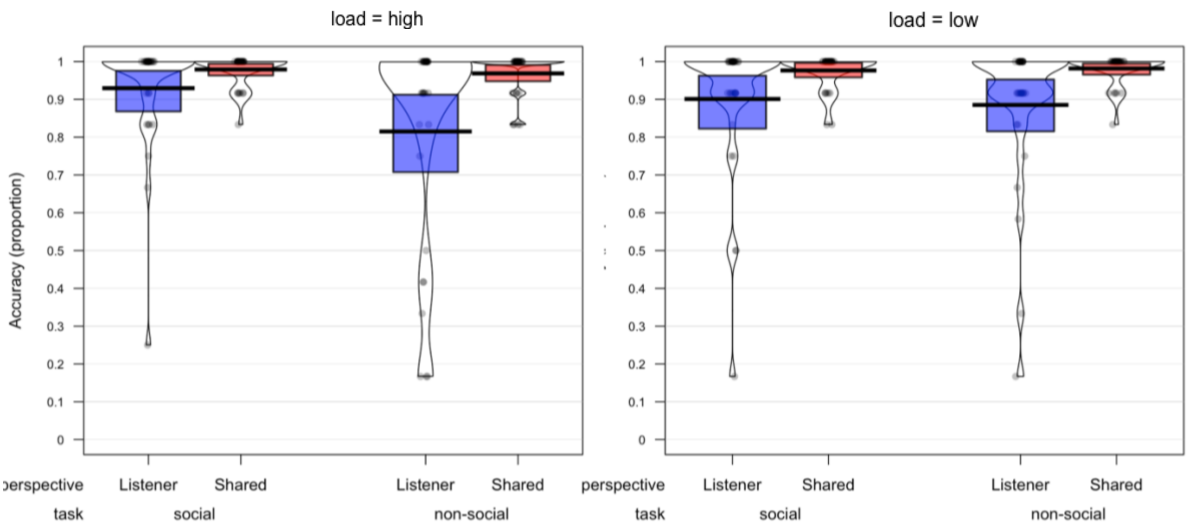
## Results

All analyses used mixed models with contrast-coded (–0.5 *vs*. 0.5) fixed effects for Task (social *vs*. non-social) and Load (high *vs*. low). Analysis of the perspective-taking task additionally included a fixed effect of Perspective (listener *vs*. shared perspective) and analysis of the prosocial task additionally included a fixed effect of Beneficiary (other/prosocial *vs*. self). Random intercepts were included for participants and items. The initial models specified the maximal random structure supported by the design, with Perspective/Beneficiary as a random slope by participant, and Task, Load and Perspective/Beneficiary as random slopes by item. If a model failed to converge, we used a backward fitting approach to simplify the random structure (Barr et al., 2013). Final model structures are detailed in the analysis script on OSF.

### *Perspective-taking*

Analyses were conducted on experimental trials for accuracy of selecting the target object and eye movement data. Areas of interest (AOIs) were defined around each object in the 4x4 grid for each visual scene, including the target object (the mutually available object that matched the director's description) and the competitor object (the object in privileged view that was either semantically matched (Listener-Perspective condition) or did not match (Shared-Perspective condition) the director's description). Eye movements to these objects were time-locked to the onset of the scalar adjective (e.g., “small” in “Move the small star one slot down”) and were analysed in a period that lasted until the participant’s selection response. Eye movements analysis examined the target bias in each condition by calculating the relative proportion of fixation duration to the target *versus* the competitor object (P(target) – P(competitor)). Accuracy data were analysed using a logit mixed-effect model, while eye movement data were analysed using a linear mixed model. The mean accuracy and target bias for each condition is presented in Figure 4.

**ACCURACY**




**EYE MOVEMENTS**

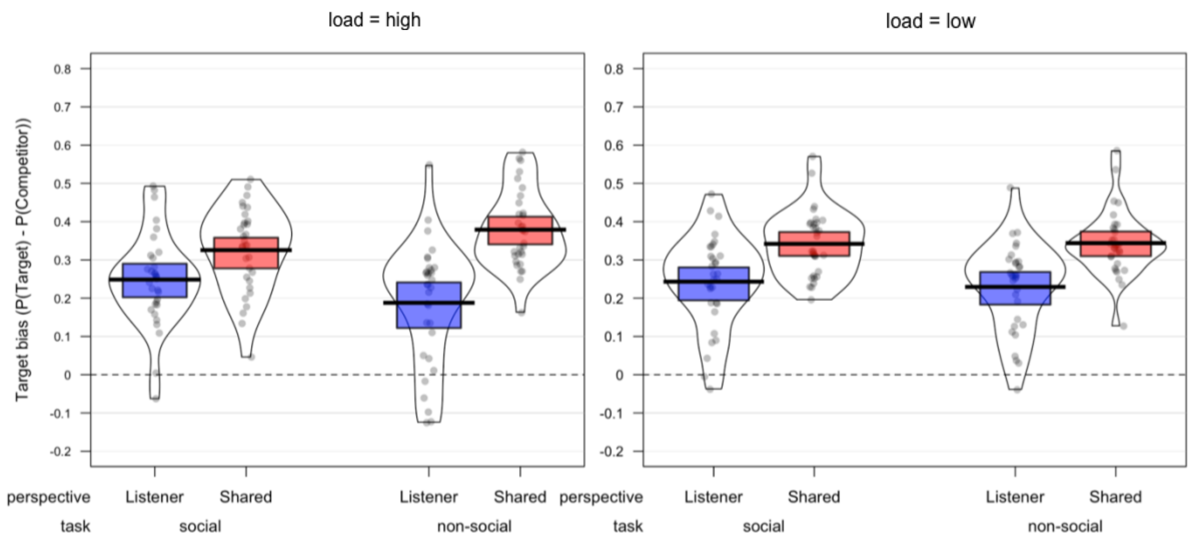


Figure 4. Top two panels show accuracy for each condition in the perspective-taking task and the bottom two panels show the target bias (i.e. proportion of fixation duration on the target minus competitor) for each condition in the perspective taking task, Experiment 1. Plots show raw data points, a horizontal line reflecting the mean and a rectangle around the mean representing the 95% Confidence Intervals.

*Accuracy:* The dependent variable was the accuracy in identifying the target object (0/1). Task (non-social /social), Load (high/low), and Perspective (listener/shared) were sum-coded and entered as fixed effects. Random intercepts included for participants and items. The maximal model specified random slopes for Perspective by participant and random slopes for Perspective, Task, and Load by item. The final model retained random slopes for Perspective by participant and by item. None of the fixed effects or interactions were significant ($ps > .135$).

*Eye movements:* The dependent variable was the proportion of target bias. Task (non-social vs. social), Load (high vs. low), and Perspective (listener vs. shared) were sum-coded and entered as fixed effects. Random intercepts were included for participants and items. The maximal model specified random slopes for Perspective by participant and random slopes for Perspective, Task, and Load by item. The final model retained only random intercepts for participants and items. The significant effect of Perspective ($\beta = .12$, $SE = .009$, $t = 12.76$, $p < .001$) revealed that participants were more likely to experience interference from the competitor in the listener perspective condition ($M = .23$, $SE = .02$) compared to the shared perspective condition ($M = .35$, $SE = .02$), meaning they found it harder to ignore the competitor object when adopting the listener perspective. The interaction between Task and Perspective was significant ($\beta = .07$, $SE = .02$, $t = 3.49$, $p < .001$), subsumed under a three-way interaction between Task, Load and Perspective, ($\beta = -.01$, $SE = .04$, $t = -2.63$, $p = .008$).

Further analysis of this interaction showed that the Task*Perspective interaction was only significant under high load ($\beta$ = .11, *SE* =.04, *t* = 2.67, *p* = .009) and not under low load (*p* = .583). In this high WM load condition, the Perspective effect was larger in the non-social task ($\beta$ = .19, *SE* = .04, *t* = 4.70, *p* < .001) than the social task, ($\beta$ = .08, *SE* = .03, *t* = 2.52, *p* = .019), reflecting greater difficulty inhibiting fixations on the competitor under high non-social load compared to high social load. All remaining fixed effects and interactions were non-significant (*p*s > .137).

*Prosocial behaviour*

Analyses were conducted on the proportion of trails participants chose the 'work' option (coded as 1) or the 'rest' option (coded as 0), using a logit mixed-effect model. Task (non-social vs. social), Load (high vs. low), and Beneficiary (other vs. self) were sum-coded and entered as fixed effects. Random intercepts were included for participants and items. The maximal model specified random slopes for Beneficiary by participant and random slopes for Beneficiary, Task, and Load by item. The final model dropped the item random intercept but retained the random slope for Beneficiary by participant. The effect of Beneficiary was significant ($\beta$ = 1.07, *SE* = .34, *z* = 3.13, *p* = .002), with participants more willing to choose the 'work' option when earning credits for themselves (*M* = 3.61, *SE* = .32) compared to an unknown other (*M* = 2.54, *SE* = .26). The significant effect of Load ($\beta$ = 1.20, *SE* = .40, *z* = 2.98, *p* = .003) revealed that participants were more likely to choose the 'work' option under low load (*M* = 3.67, *SE* = .34) than high load (*M* = 2.47, *SE* = .28), suggesting they exerted less effort under high load. None of the remaining fixed effects or interactions reached significance (*p*s > .323). The mean proportion of choosing the 'work' option for each condition is presented in Figure 5.

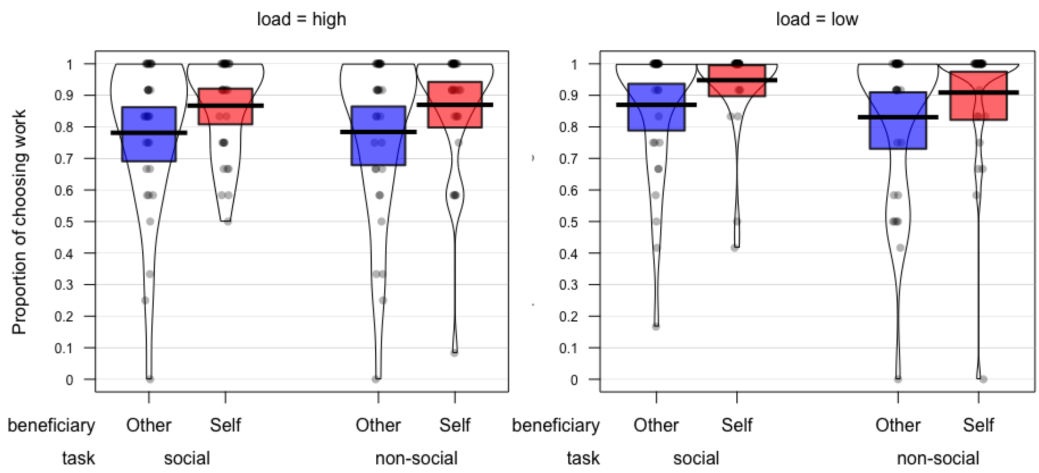
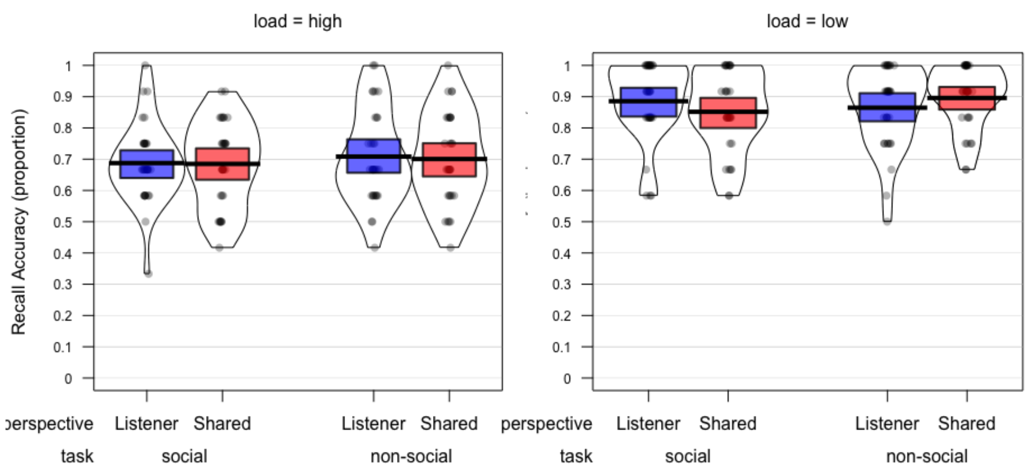



Figure 5. Proportion of choosing the 'work' option in the prosocial task in Experiment 1, showing raw data points, a horizontal line reflecting the mean and a rectangle around the mean representing the 95% Confidence Intervals.

*Working memory*

Two separate generalised linear mixed models were used to analyse accuracy scores in the WM task within the perspective-taking and prosocial tasks. Mean recall accuracy in each social task, for each condition, is plotted in Figure 6.

**PERSPECTIVE-TAKING TASK**




**PROSOCIAL TASK**

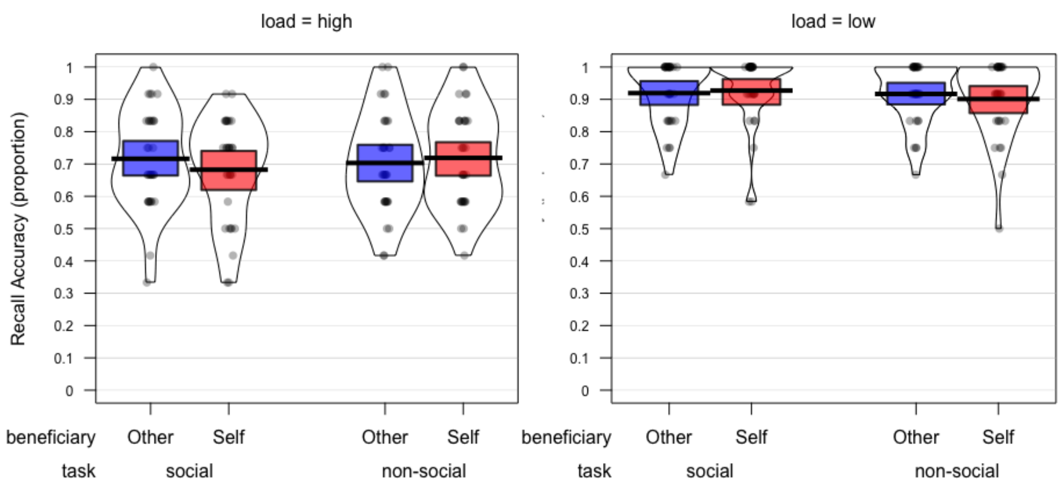



Figure 6. Top two panels show recall accuracy in the working memory task within the perspective-taking task and the bottom two panels show recall accuracy in working memory task within the prosocial task, in Experiment 1. Plots show raw data points, a horizontal line reflecting the mean and a rectangle around the mean representing the 95% Confidence Intervals.

*Perspective-taking task:* The significant effect of Load ($\beta = 1.16$, $SE = .23$, $z = 4.99$, $p < .001$) revealed that participants were more accurate under low load ($M = 2.13$, $SE = .13$) than under high load ($M = .98$, $SE = .18$). All remaining fixed effects and interactions were non-significant ($ps > .092$).

*Prosocial task:* The significant effect of Load ($\beta = 1.64$, $SE = .16$, $z = 10.48$, $p < .001$) revealed that participants were more accurate under low load ($M = 2.57$, $SE = .13$) than under high load ($M = .93$, $SE = .09$). All remaining fixed effects and interactions were non-significant ($p$s > .203).

*Correlations*

A series of non-parametric correlations examined the relationships between our measures, conducted separately for social and non-social WM groups (N=64 per group). Specifically, we examined associations between: (1) accuracy in the listener-perspective condition in the perspective-taking task (higher scores indicate less egocentric interference); (2) the target bias in the listener-perspective condition in the perspective-taking task (higher scores indicate less egocentric interference); (3) the proportion of 'work' choices when earning credits for an 'other' in the prosocial task (higher scores indicate more prosocial behaviour to help the other); (4) WM accuracy (averaged across low and high load in both the perspective-taking the prosocial tasks); and (5) features of participants' social networks, including the number of individuals in their support clique (people relied on during serious social or financial difficulties) and their sympathy group (people with whom they maintain monthly contact). Given the number of variables included in each correlation, we used False Discovery Rate (FDR) correction for the p-values, which is commonly used to adjust for multiple comparisons, including multiple correlations (Storey, 2011). The resulting correlation matrices are plotted Figure 7.

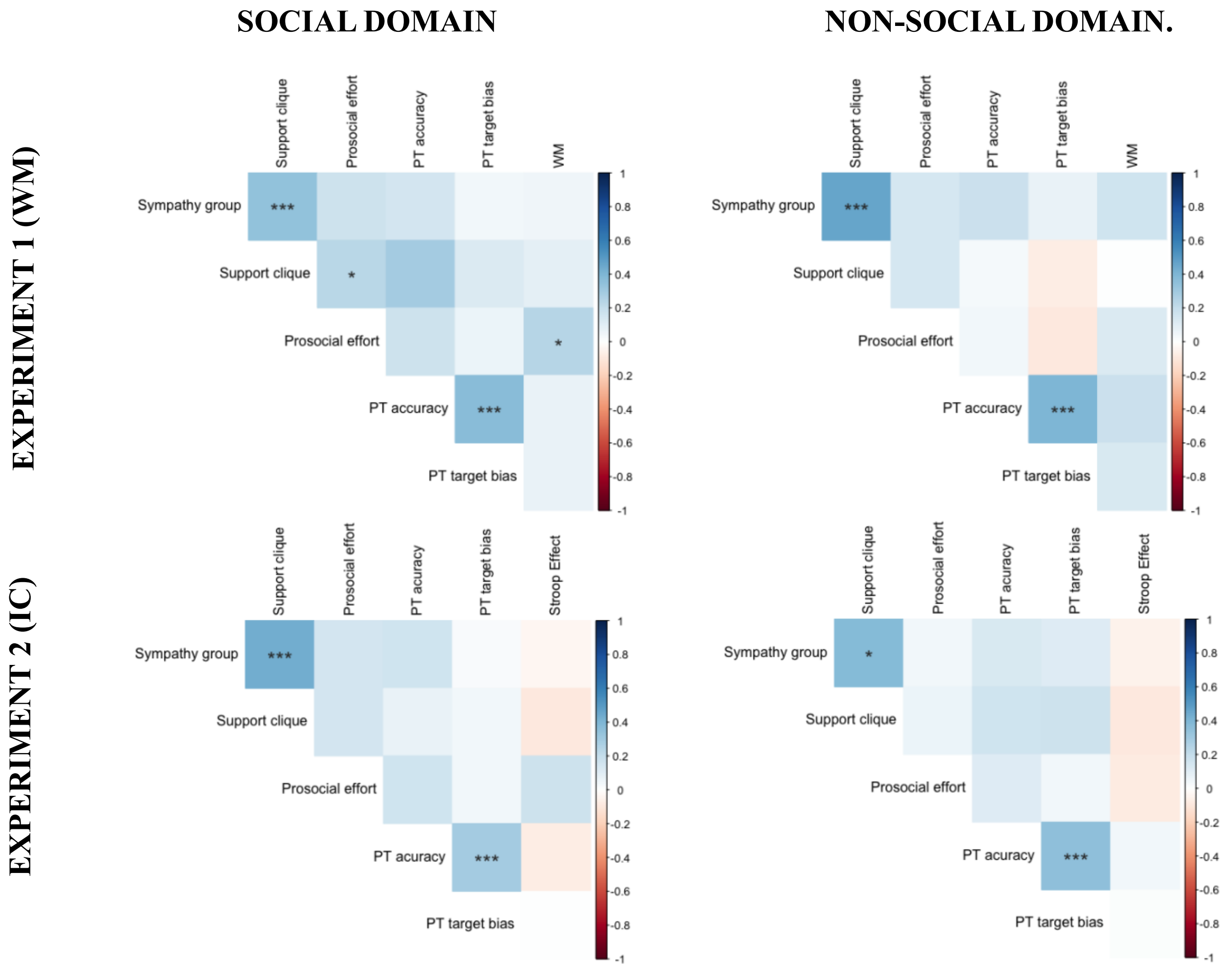



Figure 7. Left panels show the correlation matrices among all measures in the social domain, and the right panels show the correlation matrices among all measures in the non-social domain. Top panels show effects for Experiment 1 and bottom panels show effects for Experiment 2. Red-shaded cells indicate negative correlations and blue-shaded cells indicate positive correlations. Darker hues indicate stronger associations, with asterisks denoting statistical significance following FDR correction. Note: *** $p < .001$; * $p < .05$.

*Social domain:* Results showed that participants' willingness to work to earn credits for others in the prosocial task was positively correlated with the size of their support clique ($\tau = .23$, $p = .020$); individuals with a larger network of people they could rely on during serious social or financial difficulties tended to behave more prosocially. Prosocial effort was also positively correlated with social WM accuracy ($\tau = .24$, $p = .045$); individuals with a higher social WM capacity tended to behave more prosocially. Additionally, the size of participants' support clique was positively correlated with the size of their sympathy group (people with whom they maintain monthly contact;. $\tau = .35$, $p < .001$), and the behavioural accuracy measure was positively correlated with the eye movement target bias measure in the perspective-taking task ($\tau = .37$, $p < .001$).

*Non-social domain:* Correlations replicated the positive association between participants' support clique and the size of their sympathy group ($\tau = .47$, $p < .001$), as well as the association between accuracy and eye movement measures on the perspective-taking task ($\tau = .41$, $p < .001$).

*Summary*

Eye movement data in the perspective-taking task showed that participants had greater difficulty ignoring the competitor object when adopting the listener perspective compared to the shared perspective, indicating increased cognitive effort in the listener condition. Moreover, this effect was more pronounced under high non-social load than under high social load, suggesting that participants experienced greater difficulty ignoring the competitor object when their non-social WM resources were reduced than when their social WM resources were reduced. Furthermore, in the prosocial task participants were generally more willing to choose the 'work' option under low load, indicating that overall, they put in less effort when WM resources were reduced. Participants were also more likely to choose the 'work' option when earning credits for themselves than for someone else, suggesting that, overall, their behaviour was self-biased, regardless of WM load.

Therefore, while there was some evidence that loading non-social WM had a stronger impact on perspective-taking than loading social WM, we found no evidence that load differentially influenced prosocial behaviour. In contrast, correlational analyses showed that participants with higher social WM, but not non-social WM, tended to behave more prosocially, choosing to work for others more frequently. Additionally, participants' support cliques were strongly associated with their prosocial behaviour: those who had more people they could rely on during major social or financial challenges were more likely to act prosocially.

Finally, WM accuracy showed a clear effect of load (higher accuracy under low *vs.* high load) when assessed as a secondary task during both the perspective-taking and prosocial tasks. However, WM performance was not affected by the specific social manipulations (i.e. perspective or beneficiary conditions). This indicates that WM was not differentially disrupted by increased social complexity, suggesting the absence of a bidirectional influence between WM and social processing in this context.

## 3. Experiment 2

### Methods

*Participants*

131 participants were recruited using the University of [Anonymised] Research Participation Scheme. The eligibility criteria were the same as Experiment 1, and participants were compensated with course credits and/or cash. Nine participants were excluded due to low accuracy (less than 10%) in the listener perspective condition of the perspective-taking task. The final sample size was 122 participants, randomly allocated to four groups (see Table 1 for participant characteristics).

*Experimental tasks*

*Inhibitory control:* To deplete IC, two versions of the manual Stroop task were used: a non-social Stroop task and a social Stroop task. Participants had to respond to different types of conflicts; either a non-social conflict (colour-word incongruency) or a social conflict (face-gender incongruency; Wang et al., 2023). In the non-social Stroop task, colour word stimuli were presented in different colour inks. Participants were asked to categorise the ink colour of each word as either a warm colour (e.g. red, orange, or yellow) or a cold colour (e.g. blue, green, or purple), while ignoring the meaning of the word. In a congruent trial, the ink colour matched the word, and in an incongruent trial it did not. In the social Stroop task, 12 faces (6 females, 6 males) were used as stimuli, with a gender word label (i.e. "female" or "male") placed on top of each face stimuli. Participants had to respond to the gender of the person in the picture and ignore the word (see Figure 8). In a congruent trial, the gender of the person in the image matched the gender label, and in an incongruent trial it did not. Face stimuli were taken from the FACES database created at the Max Planck Institute for Human Development in Berlin, Germany (https://faces.mpdl.mpg.de/imeji/; Ebner et al., 2010).

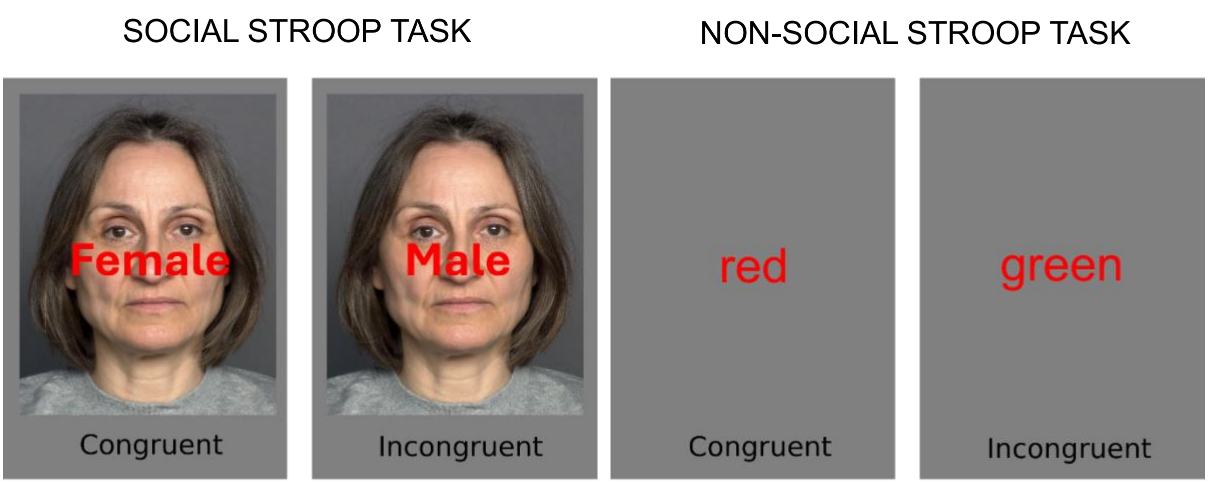



Figure 8. Examples of social and non-social stimulus versions of the Stroop tasks used in Experiment 2.

Each version of the Stroop task started with a key-binding block. Participants were instructed to use their left index finger to press the "A" key and their right index finger to press the "L" key on the keyboard. In the non-social Stroop task, there were 12 congruent trials, with each colour presented twice (6 colours * 2 times). In the social Stroop task, there were 8 neutral trials, in which face stimuli were presented without a gender label overlaid. Four faces (2 females, 2 males) were presented twice (4 faces * 2 times). Following the key-binding block, participants completed a practice block of 24 trials that included incongruent trials to familiarise them with the experience of the main task.

The main task consisted of 144 trials in both versions, divided into three blocks. Load was manipulated by varying the proportion of congruent *vs*. incongruent trials. In the high-load condition, there were 36 incongruent trials (75%) and 12 congruent trials (25%) in each block. In the low-load condition, there were 12 incongruent trials (25%) and 36 congruent trials (75%). Each trial began with a fixation cross on the centre of screen for 500ms, followed by the stimulus presentation for 2000ms, and then a 200ms inter-trial interval. At the end of the each Stroop task, participants were asked to rate the task on three items using a 4-point scale: (1) task difficulty (1= very easy to 4= very difficult), (2) perceived effort (1= no effort to 4= extreme effort), and (3) fatigue (1= not tired at all to 4= extremely tired). Each round of the Stroop task lasted approximately ten minutes.

Due to the imbalanced proportion of congruent and incongruent trials, pseudo-randomised lists were used to ensure a more even distribution of trial types. A separate set of pseudo-randomised lists was used for the second round to prevent participants from anticipating trial sequences.

*Perspective-taking, prosociality and social network:* Tasks to measure perspective-taking and prosociality were identical to those used in Experiment 1, except there was no concurrent secondary task. Social network was assessed with a questionnaire, as detailed above.

*Procedure*

Participants completed two rounds of the Stroop task during the session, once before the perspective-taking task and once before the prosocial task. The aim was to deplete IC prior to completing each of these tasks. The order in which participants completed the perspective-taking and prosocial tasks was counterbalanced across participants. The second round of the Stroop task was identical to the first, except that it did not include the key-binding block. All other aspects of the procedure match that used in Experiment 1.

## Results

Analyses followed the same structure as detailed in Experiment 1, and final model structures are detailed in the analysis script on OSF.

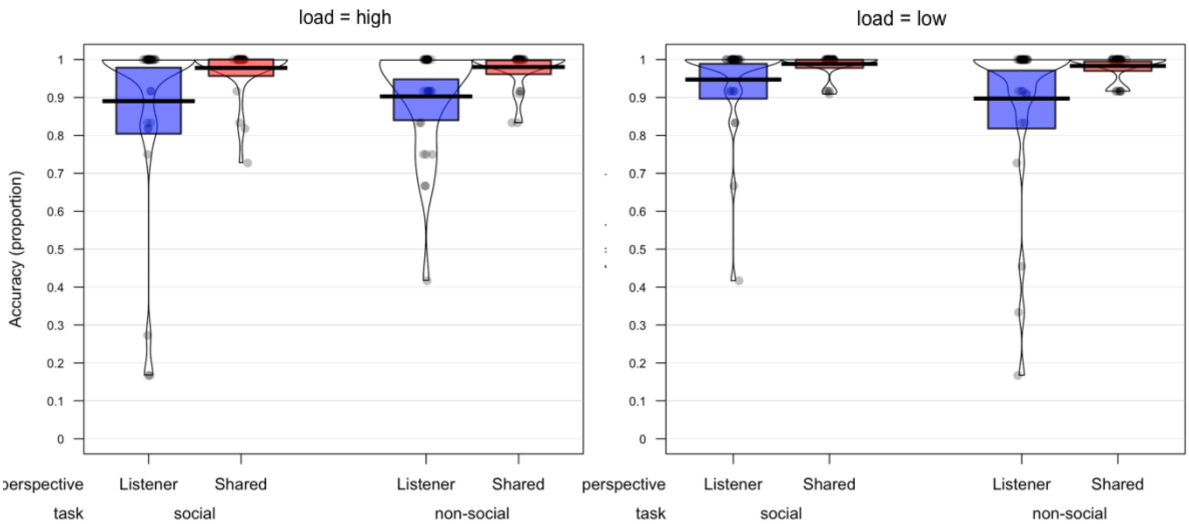
*Manipulation check- Stroop task difficulty*

Participants rated the Stroop task in terms of difficulty, perceived effort, and fatigue before each social task, and an exploratory analysis verified that the load manipulation was effective. Ratings were analysed using a mixed-effects model, with task (non-social *vs.* social) and load (low *vs.* high) as fixed effects and a random effect for participant. The outcome variable was the raw rating for each question and Stroop block (1-4). The analysis revealed a significant effect of load ($B = -0.27$, $SE = 0.14$, $t = -2.00$, $p = .049$), indicating that the high load Stroop task was perceived as more demanding overall than the low load Stroop task. The effect of Task was non-significant ($B = -0.24$, $SE = 0.13$, $t = -1.76$, $p = .082$), but suggested a trend for the non-social Stroop being rated as more demanding than the social Stroop version. The interaction between the two was non-significant. Although subjective ratings cannot serve as a direct measure of ego depletion, they provide an independent assessment of perceived effort and task demand that support the manipulations here.

*Perspective-taking*

A logit mixed-effect model was used to analyse perspective-taking accuracy and a linear mixed-effect model was used to analyse eye movements (target bias). The mean accuracy and target bias for each condition is presented in Figure 9.

**ACCURACY**




**EYE MOVEMENTS**

load = high

load = low

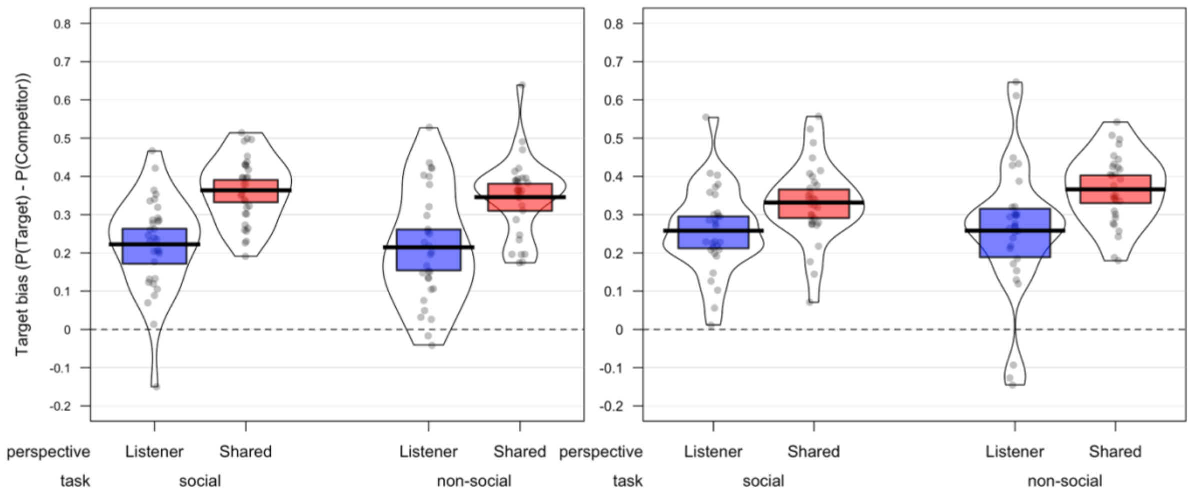



Figure 9. Top two panels show accuracy for each condition in the perspective-taking task and the bottom two panels show the target bias (i.e. proportion of fixation duration on the target minus competitor) for each condition in the perspective taking task, Experiment 2. Plots show raw data points, a horizontal line reflecting the mean and a rectangle around the mean representing the 95% Confidence Intervals.

*Accuracy:* The dependent variable was accuracy in identifying the target object (0/1). Task (non-social vs. social), Load (high vs. low), and Perspective (listener vs. shared) were sum-coded and entered as fixed effects. Random intercepts were included for participants and items. The maximal model specified random slopes for Perspective by participant and by item. The final model converged without error and was identical to the maximal model. None of the fixed effects or interactions were significant (*p*s > .199).

*Eye movements:* The dependent variable was the proportion of target bias. Task (non-social/social), Load (high/low), and Perspective (listener/shared) were sum-coded and entered as fixed effects. Random intercepts included participant and item. The full model included random slopes for Perspective by-participant and for Perspective, Task, and Load by-item. The final model converged with Perspective included as random slopes by-participant and by-item. The effect of Perspective was significant ($\beta$ = 0.11, *SE* = 0.01, *t* = 6.24, *p* < .001), showing that participants experienced greater interference from the competitor in the listener perspective condition (*M* = .24, *SE* = 0.02) compared to the shared perspective condition (*M* = .35, *SE* = 0.02). None of the remaining fixed effects or interactions were significant (*p*s > .131).

*Prosocial behaviour*

A logit mixed-effects model was fitted. The dependent variable was the choice to work versus rest (0/1). Task (non-social vs. social), Load (high vs. low), and Beneficiary (other vs. self) were sum-coded and entered as fixed effects. Random intercepts were included for participants and items. The maximal model specified random slopes for Beneficiary by participant and by item. The final model dropped the item random intercept but retained the random slope for Beneficiary by participant. A significant main effect of Beneficiary ($\beta$ = 1.61, *SE* = 0.37, *z* = 4.37, *p* < .001) showed that participants were more likely to choose to work for themselves (*M* =4.15, *SE* = 0.36) than for others (*M* = 2.54, *SE* = 0.25). There were no significant effects of Task or Load (*p*s > .176), and none of the interactions were significant (*p*s > .272). The mean proportion of choosing the 'work' option for each condition is presented in Figure 10.

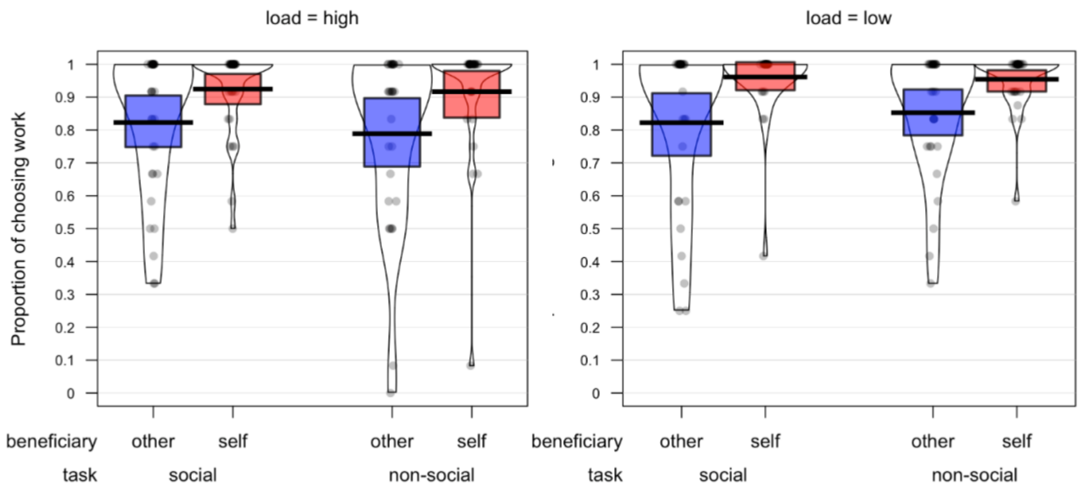



Figure 10. Proportion of choosing the 'work' option in the prosocial task in Experiment 2, showing raw data points, a horizontal line reflecting the mean and a rectangle around the mean representing the 95% Confidence Intervals.

*Inhibitory control*

A linear model was used to analyse Stroop task data as a function of Task and Load, with data combined across the two rounds. The Stroop effect was calculated by subtracting the mean RT of congruent trials from that of incongruent trials. Due to the unequal number of incongruent and congruent trials, mean RTs were aggregated within each condition, resulting in one observation per participant. Mean Stroop effects for each condition are plotted in Figure 11.

There was a significant effect of Load ($\beta$ = -41.69, *SE* = 9.51, *t* = -4.38, *p* < .001), indicating a larger Stroop interference effect under low load (i.e. lower proportion of incongruent trials; *M* = 72.50, *SE* = 6.78) compared to high load (i.e. higher proportion of incongruent trials; *M* = 30.90, *SE* = 6.67). A significant effect of Task ($\beta$ = 46.68, *SE* = 13.55, *t* = 3.44, *p* < .001) also showed that the Stroop effect was larger in the non-social domain (*M* = 72.80, *SE* = 6.78) than the social domain (*M* = 30.60, *SE* = 6.67).

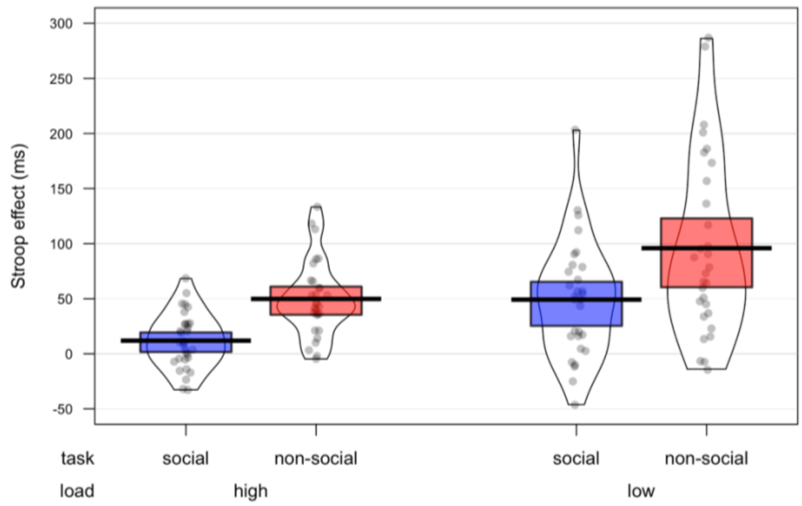



Figure 11. Stroop effect (i.e. the difference in reaction times on congruent *minus* incongruent trials) as a function of Task and Load in Experiment 2. Raw data points are displayed, a horizontal line reflecting the mean and a rectangle around the mean representing the 95% Confidence Intervals.

*Correlations*

As in Experiment 1, we ran a series of correlation analyses, separately for each domain (N=62 social and N=60 non-social). The resulting correlation matrices are plotted Figure 7.

*Social domain:* Replicating effects in Experiment 1, the two measures of social network (support clique and sympathy group) were positively correlated with each other ($\tau = .44$, $p < .001$), and behavioural accuracy and eye movement target bias in the perspective-taking task were also positively correlated with each other ($\tau = .30$, $p < .001$).

*Non-social domain:* Similar to correlations in Experiment 1 and in the social domain, the size of participants' sympathy group was positively correlated with their support clique ($\tau = .38$, $p = .011$), and perspective-taking accuracy was positively correlated with eye movement target bias in this task ($\tau = .36$, $p < .001$).

*Summary*

Experiment 2 replicated the basic within-subjects effects observed in Experiment 1. In the perspective-taking task, participants looked more frequently at the competitor in the listener perspective condition than in the shared perspective condition, and in the prosocial effort task, participants were more likely to work for themselves than for another person. However, IC depletion (manipulated via Task or Load) did not modulate these perspective-taking or prosocial effects. Analysis of the Stroop task confirmed that the Task and Load manipulations were effective; the Stroop effect was larger when the ratio of incongruent trials was low *vs.* high, and larger in the non-social *vs.* social domain. Finally, none of the correlations with IC capacity (i.e. size of the Stroop effect) reached significance, suggesting that individual differences on this measure did not predict perspective-taking or prosocial behaviour.

## 4. General Discussion

In two pre-registered experiments, we investigated the role of executive capacities in shaping social behaviour by testing the extent to which social *versus* non-social WM load and IC depletion disrupt perspective-taking and prosocial behaviour. In Experiment 1, participants completed a dual-task in which they memorised either two (low-load condition) or five words (high-load condition) and concurrently completed the referential communication “director” task (measuring perspective-taking) and a prosocial task (choosing to "work" to earn credits for themselves or another person). The memorised words were either social adjectives (social WM) or non-social adjectives (non-social WM). In Experiment 2, IC was depleted using a Stroop task that included either a low number of incongruent trials (25%; low-load condition) or a high number of incongruent trials (75%; high-load condition) before they completed the perspective-taking and prosocial behaviour tasks. The Stroop task stimuli were either combinations of face-gender labels (social IC) or colour-words (non-social IC).

The results from Experiment 1 suggest that working memory constrains perspective-taking primarily through domain-general mechanisms, while domain-specific contributions emerge more modestly in prosocial behaviour at the level of individual differences in social working memory. Eye-tracking data from the perspective-taking task showed that participants found it harder to ignore a competitor object in their privileged view (i.e. listener-perspective condition) compared to an irrelevant object in mutual view (i.e. shared-perspective condition), especially under high WM load. Crucially, although this interference effect was present under both social and non-social WM load, it was significantly stronger in the non-social WM condition. This pattern suggests that the ability to inhibit one's own perspective relies on WM resources, and that this process is more vulnerable when WM capacity is taxed from a different domain, perhaps because the two tasks draw on fewer shared processing mechanisms. These findings align with Barzy et al. (2025) who reported positive associations between individuals' cognitive, but not social, WM and perspective-taking ability. They are also consistent with a broader literature demonstrating a link between WM and perspective-taking, particularly studies employing tasks that rely on cognitive WM (Nilsen & Bacso 2017; Wardlow, 2013; de Wilde et al., 2016) and those using dual-task paradigms to experimentally manipulate WM load (e.g. Cane et al., 2017; Lin et al., 2010; Qureshi et al., 2010). In addition, the form of perspective-taking measured here can be characterised as primarily cognitive, involving the ability to infer others' thoughts, viewpoints, or beliefs, rather than an affective or emotion-based process (Healey & Grossman, 2018). Because of this cognitive emphasis, it is perhaps theoretically expected that cognitive WM load would interfere more strongly with PT than social WM load, as we observed, given that both draw on overlapping domain-general cognitive control processes.

Experiment 1 also replicated previous studies in showing that participants were more willing to exert effort for themselves than for others (Contreras-Huerta et al., 2022). While high WM load reduced overall effortful behaviour in this task, this effect did not interact with beneficiary, suggesting that WM demands disrupted general effortful behaviour rather than selectively affecting self- or other-directed prosocial motivation. This indicates that executive capacity supports the maintenance of effortful behaviour regardless of the beneficiary, likely through its role in sustaining motivation and self-regulation. These findings align more closely with intuitive accounts of prosocial and cooperative behaviour, which argue that under cognitive or time pressure, individuals rely less on deliberative cost–benefit reasoning and more on automatic or habitual tendencies. Previous research suggests that such automaticity can enhance prosociality when cooperation is normative or socially rewarded (Rand et al., 2012; Van't Veer et al., 2014). In the current study, high WM load may have impaired not only deliberation but also participants' overall capacity to engage meaningfully with the task. Nevertheless, individual differences provided additional insight. Specifically, greater prosocial effort towards others was positively associated with social, but not non-social, WM accuracy. This correlation may reflect a trait-like capacity, whereby individuals with stronger social WM are more inclined, or better equipped, to engage in prosocial behaviour, potentially due to their enhanced ability to manage and maintain socially-relevant information.

The effectiveness of the dual-task WM load manipulation was confirmed by analyses showing that WM accuracy was significantly lower under high load than low load in both tasks. No difference in WM performance emerged for social *vs.* non-social domains, and none of the social-specific task variables influenced WM. This suggests a unidirectional interference effect: while WM load influenced social behaviour (e.g. perspective-taking and effort), the social tasks did not significantly impair WM accuracy. These findings are consistent with models proposing that WM operates as a domain-general resource whose capacity constraints can impact social behaviour, even if the social demands themselves do not reciprocally impair executive functioning (Apperly, 2010; Meyer & Lieberman, 2012; Qureshi et al., 2010).

In Experiment 2, the basic social effects were replicated (i.e. perspective and beneficiary), however IC depletion did not impact perspective-taking or prosocial behaviour, suggesting that IC may play a less central role in these social processes than WM. However, it is also possible that the null effects reflect limitations of the IC depletion paradigm itself. Because the depletion task ran sequentially, rather than concurrently with the social tasks, participants may have had time to recover or engage compensatory processes to reduce the impact of depletion. Moreover, while some studies have reported ego-depletion effects on socio-cognitive outcomes (Fennis, 2011; Nie et al., 2025; Ugur, 2021; Xu et al., 2012; Zha et al., 2025), the evidence is inconsistent. Several high-powered replication attempts have failed to detect reliable effects of ego-depletion, raising questions about its validity as a manipulation of executive control (Hagger et al., 2016; Hurley, 2023; Lurquin et al., 2016). Nonetheless, the lack of significant associations between individual differences in IC and any of the social measures (perspective-taking, prosociality or social network) suggests that the relationship between IC and social cognition is likely weaker than that observed for WM.

Analysis of the Stroop task data confirmed that the load manipulations were effective: Stroop interference was greater under low load than high load (see also Supplementary Materials for an analysis of Stroop effects building up over trials), and greater in the non-social domain than the social domain. Self-report ratings of Stroop difficulty, effort and fatigue also showed that high load trials were rated as significantly more demanding than low load trials, further supporting the effectiveness of the load manipulation. Although the larger Stroop effect under low load may appear counterintuitive, it likely reflects increased difficulty in managing interference when incongruent stimuli were less frequent. Infrequent incongruent stimuli can lead to reduced expectancy or heightened surprise, making them harder to inhibit when they do appear.

Finally, the correlations suggested a role for social networks. Participants with a larger support clique tended to behave more prosocially (Experiment 1 social domain groups, but not replicated in other groups). This aligns with previous research suggesting that support clique size is predicted by individual differences in social cognition (Stiller & Dunbar, 2007), and that stronger socio-cognitive abilities may help individuals maintain close social relationships (Morelli et al., 2017).

This study makes several novel contributions to the literature. First, it is among the few empirical investigations to directly test whether loading inhibitory control influences perspective-taking or prosociality, providing an important extension to previous work that has focused primarily on working memory. Second, we distinguished between social and cognitive forms of inhibitory control and working memory, offering a more fine-grained examination of how different domains of executive functions relate to social behaviour. Third, although the role of working memory in perspective-taking has been well documented, its influence on prosocial behaviour has been more inconsistent; our study addresses this gap by combining tasks to assess prosociality under varying cognitive demands. There are alsoseveral important limitations to the current experiments. First, the absence of significant effects of IC on perspective-taking or prosociality may stem from our choice to use a sequential ego-depletion paradigm rather than a concurrent dual-task design. Although ego-depletion tasks have been widely used to capture IC, the robustness of this effect has been questioned, with several studies reporting inconsistent or null findings (e.g., Hagger et al., 2016). We carefully considered alternative paradigms, including dual-task approaches with different modalities (e.g. auditory IC tasks) that could be run concurrently with the social tasks. However, the literature currently lacks tasks that can clearly distinguish IC from WM processes. Even well-established IC tasks often engage WM to some extent, complicating efforts to isolate their effects (Conway et al., 2001; Sörqvist, 2010, Yurgil & Golob, 2013). We selected an ego-depletion task to minimise WM-related confounds, however its sequential nature may have reduced ecological validity or task engagement.

These issues, along with evidence that reduced inhibitory control after prior effort reflect motivational and attentional shifts rather than depletion of a limited resource (Job & Walton, 2011; Inzlicht & Friese, 2019), suggest that our null IC findings should be interpreted with caution, as the ego-depletion manipulation may not have sufficiently reduced inhibitory control. Future research should focus on developing novel dual-task paradigms that are capable of isolating IC from WM demands, or at least minimising their overlap, to enable a clearer interpretation of causal mechanisms. Second, the current study focused narrowly on one specific dimension of prosocial behaviour: effort-based, the goal-directed behaviour, operationalised as participants' willingness to exert effort to benefit the self or another person. While this form of prosociality is highly relevant for social decision-making, it represents only a fraction of the broader multidimensional construct that includes spontaneous helping, cooperative behaviour and moral reasoning (Carlo & Padilla-Walker, 2020). These other forms of prosociality may draw on partially distinct cognitive and social processes. Expanding future research to include diverse forms of prosocial behaviour will be critical for building a more comprehensive account of how executive functions shape social behaviour. Finally, none of the behavioural effects reached significance for perspective-taking (accuracy), suggesting that adults' explicit performance may have been close to ceiling and that implicit methods, such as eye-tracking, provide a more sensitive measure to assess load effects in this task.

In conclusion, the findings from these two experiments offer novel insights into the cognitive mechanisms that support perspective-taking and prosocial behaviour. We demonstrated that WM load, particularly in the non-social domain, can impair perspective-taking performance, with eye-tracking data revealing sensitivity to real-time processing demands. Additionally, participants who acted more prosocially tended to have higher social WM and larger support cliques, highlighting distinct contributions for social and non-social WM in supporting different social behaviours. There was no evidence that WM performance was influenced by social complexity of the task, suggesting a unidirectional effect from WM to social skills. In contrast, loading inhibitory control capacities did not elicit significant effects on social behaviour. These findings contribute to a growing body of research differentiating social and non-social domains of executive functions in relation to social behaviour, and underscore the methodological challenges of experimentally manipulating IC in isolation from WM. Future research should build on these results by developing dual-task paradigms capable of concurrently taxing IC, and extending the studies to include more diverse, naturalistic expressions of prosociality.

## Constraints on Generality

The findings reported here are based on two experiments conducted with predominantly Western, university-aged participants, which limits the generalisability of the results and should be acknowledged. In addition, the samples were predominantly female, although gender was distributed relatively evenly across experimental conditions; future work with more gender-balanced samples would strengthen the generalisability of the findings. Given known cross-cultural, developmental, and gender-related differences in executive functioning and social cognition, caution should be exercised when extending these results to non-Western populations, older adults, children, or more gender-diverse samples. That said, the tasks used to manipulate perspective-taking and inhibitory control have previously been employed in non-Western contexts, suggesting some potential for broader applicability. Nonetheless, the lab-based nature of these tasks may not fully reflect the complexity of these processes in real-world social situations. Furthermore, our focus was limited to specific aspects of prosociality, which is a multifaceted construct. Future research should explore whether similar patterns emerge across more diverse populations and in more ecologically valid settings.

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