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Grasping the concept of personal property

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ABSTRACT

The concept of property is integral to personal and societal development, yet understanding of the cognitive basis of ownership is limited. Objects are the most basic form of property, so our physical interactions with owned objects may elucidate nuanced aspects of ownership. We gave participants a coffee mug to decorate, use and keep. The experimenter also designed a mug of her own. In Experiment 1, participants performed natural lifting actions with each mug. Participants lifted the Experimenter's mug with greater care, and moved it slightly more towards the Experimenter, while they lifted their own mug more forcefully and drew it closer to their own body. In Experiment 2, participants responded to stimuli presented on the mug handles in a computer-based stimulus–response compatibility task. Overall, participants were faster to respond in trials in which the handles were facing in the same direction as the response location compared to when the handles were facing away. The compatibility effect was abolished, however, for the Experimenter's mug – as if the action system is blind to the potential for action towards another person's property. These findings demonstrate that knowledge of the ownership status of objects influences visuomotor processing in subtle and revealing ways.

1. Introduction

> "Men would live exceedingly quiet if these two words, mine and thine were taken away." Anaxagoras (500 BC–428 BC)

The concept of ownership has been incredibly important to humans for thousands of years. Possessions are an integral part of self identity (Belk, 1988; Dittmar, 1992); we spend much of our time and resources acquiring and avoiding the loss of our things. Moreover, at a societal level, the management of property is an organising principle of government and law enforcement. The concept of ownership and private property can be highly variable at a societal level; what one society recognises as being important property might not be recognised in another (Etzioni, 1991). Hence, the development of culture is linked intrinsically to how property is managed (e.g. Maddux et al., 2010; Mehta & Belk, 1991). Given the importance western society places on private property, possessions, and ownership, it is no surprise that ownership has been studied in a range of disciplines. To date investigations into ownership in the cognitive sciences have focused on select phenomena associated with modelling economic markets and valuation judgements (Beggan, 1992; Kahneman, Knetsch, & Thaler, 1990; Thaler, 1980). Here, we draw on the idea that higher-level processes and cognitive abstractions may be linked to perception and action, and propose that the visuomotor system responds differently to our own property compared with objects owned by other individuals.

1.1. Self-owned property

Research has focused primarily on property in the first person – how does one represent one's own property? For example, work in behavioural economics reveals that we place greater value on objects once we are given

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ownership rights to them (the 'endowment effect'; Thaler, 1980). This greatly influential finding has also been demonstrated with a number of different items, including the type of stimuli used in the present study: coffee mugs. When given a coffee mug, participants demand a higher selling price for their mug than what they would be willing to pay for an identical item when seeking to purchase. This is a classic effect demonstrating irrationality in markets (Kahneman et al., 1990; Maddux et al., 2010). Further, the 'mere ownership' effect demonstrates an affective influence of ownership: people prefer and give significantly more positive evaluations to items they own compared to those they do not (Beggan, 1992).

The link between possessions and the self may help to explain why we provide higher valuations (the endowment effect) and positive attributes (mere-ownership effect) to owned items. That is, our tendency to have a positive bias towards ourselves (e.g. Koole, Dijksterhuis, & van Knippenberg, 2001) also extends to our property (Gawronski, Bodenhausen, & Becker, 2007). Further, the self-relevance of our property may give rise to stronger memory representations of our possessions relative to unowned objects (Cunningham, Turk, Macdonald, & Macrae, 2008; van den Bos, Cunningham, Conway, & Turk, 2010).

1.2. Property owned by others

Inappropriate interaction with objects that one does not own can have negative consequences. Picking up someone's drink in a bar might lead to a costly violent altercation. Relieving someone of their widescreen television might attract unwanted attention from law enforcement agents. As well as protecting one's own possessions from others, it is equally critical that one keeps track of who owns everything else in the environment to avoid costly transgressions. To function in society, one must rapidly learn to detect the cues of ownership and conform to the given societal norm of one's culture. This is demonstrated by the finding that children learn possessive pronouns by the age of 16 months (Fenson et al., 1994). By the age of two years, they understand when someone owns an object even though a third person may be in possession of it (Fasig, 2000). By age four, children infer an object's owner as the individual who controls permission of use (Neary, Friedman, & Burnstein, 2009). This is an important rule one must learn – you can use your own object as you wish, but can only touch others' objects under special circumstances.

Another cue to third-party ownership is knowing who spent resources on the object. For example, the role of effort investment as a cue to ownership has a long theoretical history. From Locke's 'Labour Theory of Property' (1690/1947), one may posit that creative labour in the production of an object is a strong route to acquiring a sense of ownership (see also Sartre, 1943/1989). Four-year olds are able to generalise Locke's theory beyond their own possessions to other people's property: they take into account the creative labour invested in an object when deciding which third party owns it (Kanngiesser, Gjersoe, & Hood, 2010).

These developmental studies are clear examples that show tracking the ownership status of, and regulating our behavioural interactions with objects that are owned by other individuals is critical to social cognition. Due to the critical nature of physical interaction with property at the basic level of owning artefacts, we hypothesise that objects owned by other individuals will be treated very differently by the visuomotor system compared with how it treats our own property.

1.3. Property and the visuomotor system

As illustrated above, the possession of physical objects is a fundamental type of property ownership. To make and use property, one must physically interact with it. Moreover, as noted above, we use cues from others' physical interactions with objects to determine ownership status (Kanngeisser et al., 2010). It may be that the converse is also true: ownership status may affect ones physical interactions with objects. An increasingly important theoretical notion in cognitive science is the idea that high-level cognitions can be reflected in, and influenced by, bodily states (e.g. Niedenthal, 2007). Evidence for the 'embodiment' of abstract concepts has been found for preferences (Beilock & Holt, 2007; van den Bergh, Vrana, & Eelen, 1990), social perception (Tipper & Bach, 2008), political affiliation (Oppenheimer & Trail, 2010) and stereotypes (Mussweiler, 2006). For example, it has been demonstrated experimentally that when one considers the future, one leans forward slightly, but leans back if pondering the past (Miles, Nind, & Macrae, 2010). The concept of ownership could also bias the action system in related ways, especially given the often 'concrete' nature of physical property – much of our interaction with property is active. Hence, we conducted two experiments to determine if the concept of property is indeed represented in the visuomotor system and can thereby influence our interactions with objects that we own, and objects that another individual is known to own.

1.4. The present study

Overall, we hypothesise that participants will exhibit facilitated interactions with their own property and a reticence to interact with other people's property. This should be revealed in task performance when objects vary as a product of owner. In Experiment 1, participants performed natural actions with mugs that differed in terms of ownership. We analysed the trajectory and acceleration as the mugs moved through space. Acceleration of the hand has been linked previously to the perceived fragility of an object; we are less forceful when approaching fragile objects (Savelsbergh, Steenbergen, & van der Kamp, 1996). As already noted, developmental research shows that the ability to determine ownership status is a valuable skill that children quickly acquire. This may be because violating the social norms associated with property could have negative consequences. Breaking one's own object is a waste of resources, but inappropriate treatment of others' property might land you in jail or with a bloody nose. A less drastic consequence of careless use of another's property is embarrassment or social exclusion. For these reasons, we predict that the motor system will spontaneously take more care, as evidenced by less force, with other-owned items as compared with those that are self-owned.

We also anticipate that ownership status will influence the spatial aspects (i.e. trajectory) of the mug lifting action. If rich representations associated with the ownership status of mugs leak into the action system, then we expect that participants will draw their own mug slightly closer towards themselves spontaneously during the lifting phase and will push the other-owned mug slightly away. This will reflect facilitation for interacting with one's own property and a reluctance to interact with objects owned by other people. In sum, the action system will reveal the activation of high-level concepts relating to the social norms of interacting with property.

In Experiment 2, we looked at automatically evoked action in relation to ownership status With a computer-based stimulus–response compatibility (S-RC) task (see Hommel, 2000; Proctor, in press, for reviews) to investigate automatically evoked action towards mugs with different owners. In this paradigm, responses are facilitated when they are lateralised to the same side of space as the imperative stimulus (Simon, 1969). Extending this general finding to graspable objects, Tucker and Ellis (1998) showed that objects automatically potentiate components of the actions they afford. That is, a mug with a handle on the right will facilitate right-handed responses. In terms of the present study, we predict that the motor codes associated with one's own objects will be stronger than those associated with other mugs. Furthermore, we also predict that the action system will suppress the potential for interaction with other people's property. Hence, the overall compatibility effect will be relatively strong for the participant's own mug, but rather weak for experimenter's mug.

Using these two different approaches we provide converging evidence suggesting that differentiating between self- and other owned objects influences the action system. As such, this is the first evidence that ownership influences visuomotor processing and performance.

2. Experiment 1

We gave participants white ceramic coffee mugs to decorate and own. The mugs were theirs to keep even after the experiment concluded. With motion capture cameras, we recorded natural lifting and replacing actions with their own mug, one introduced as being owned by the Experimenter and one without an explicitly-defined owner. To assess the impact of ownership status on object-oriented action, we measured acceleration and spatial displacement of the mugs while they were lifted off the table surface.

2.1. Method

2.1.1. Participants

Nineteen right-handed individuals volunteered to take part in both experiments (mean age = 20.11 years, *SD* = 4.61 years; three were male). Participants were unaware of the purpose of the experiment, gave informed consent, and received course credit in return for participation.

2.1.2. Materials and apparatus

Twenty-one physically identical white ceramic mugs served as stimuli (height 10 cm, diameter of base 6 cm, weight 0.33 kg). Participants were invited to decorate one mug using an assortment of eighteen colours of enamel paint, then take it home to use daily. Participants returned to the laboratory between 12 and 16 days later (*M* = 14.3 d, *SD* = 1.2 d), and completed both Experiments 1 and 2. Self-reported usage rates ranged from 0.40 to 4.20 times per day (*M* = 1.31, *SD* = 0.86). For each participant, their own decorated mug, a decorated mug introduced as the experimenters, and an undecorated mug ('Unowned') served as reach targets. Movement in Cartesian coordinate space (x = left–right; y = forward-back; z = up–down) was captured at 100 Hz using a Qualisys ProReflex motion tracking system and a reflective marker placed on each mug, two centimetres below the rim. The kinematics of the hand were also measured, but we focus solely on how participants moved the mug itself.

2.1.3. Design and procedure

We used a single factor within-subjects design. 'Mug Ownership' had 3 levels: Participant, Unowned, and Experimenter. Although we explicitly informed participants that the Experimenter's mug was owned by the Experimenter, we did not mention the ownership status of the 'Unowned' mug. Each trial began with the participant's eyes closed and their right hand resting at the edge of the table with their index finger and thumb resting together at a marked point. The experimenter then placed one of the three mugs on the table at one of three pre-marked locations 30 cm from the starting position (directly in front of the participant or 40° to the left and right; see Fig. 1). We instructed participants to open their eyes after a tone sounded, and reach, grasp the handle, lift, and then replace the mug in a natural, fluent action. They then returned their hand to the starting position. A total of 108 actions were performed, 36 for each mug split evenly across the three locations. Mug type and location were selected randomly on each trial.

2.1.4. Data analysis

After removing trials with recording errors (0.01%), we calculated three measures to analyse the spatial trajectory of the mug during the lift and replace phase of the actions. 'Lift Height' was the maximum height reached by the mug while being lifted by the participant (i.e. 'z-max'). Displacement of the mug marker at this 'z-max' point along the x- and y-axes were calculated as measures of spatial displacement relative to the original location of the mug (producing the measures 'x at z-max' and 'y at z-max). To analyse the in-flight force (acceleration and deceleration) applied to the mug during transport, we calculated two measures. 'Peak acceleration during lift' was calculated as the maximum acceleration (in metres per second squared) that occurred between the beginning of the lift and maximum height. 'Peak deceleration during replacement' was calculated as the maximal deceleration of the mug between 'z-max' and when the mug had come to rest back on the table.

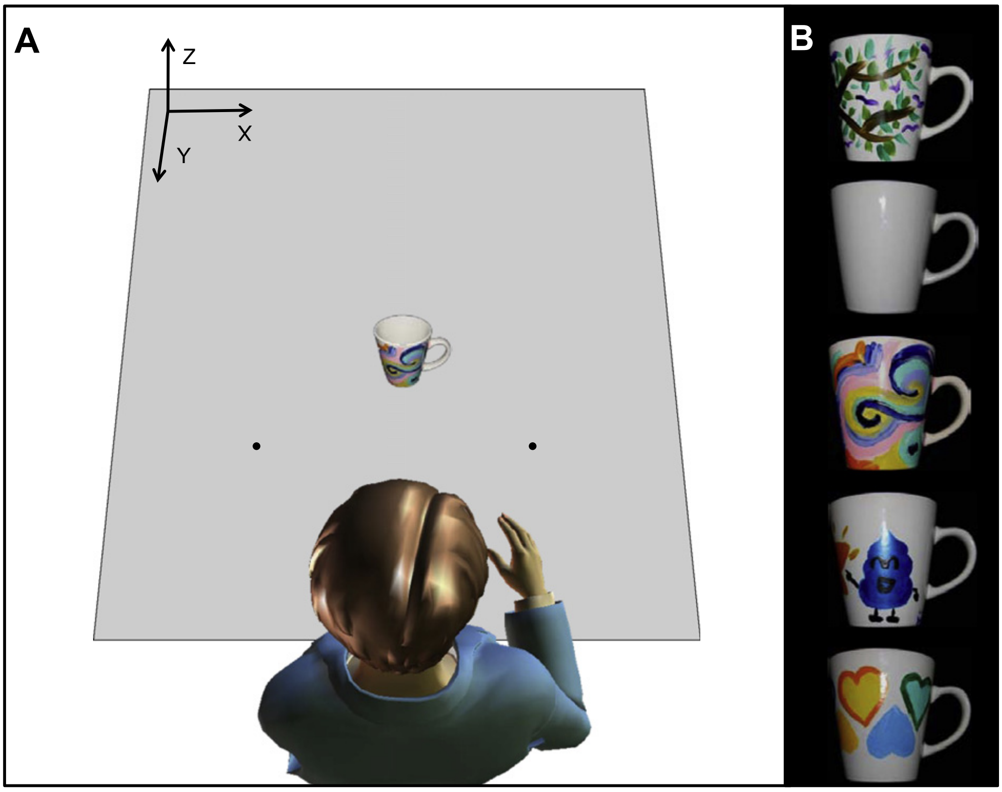

Fig. 1. Panel A: Illustration of the experimental set-up (not to scale) for Experiment 1. The mug is positioned at one of three marked locations in front of the Participant, with the Experimenter positioned to the right. The task was simply to reach for, pick up and replace the mug. Panel B: Examples of mugs used. From top, Experimenter's mug, Unowned mug, three Participants' mugs.

2.2. Results & discussion

Before focusing on the parameters of primary interest, we present some general features of the actions. The participants were making natural and fluid actions; average movement initiation time was 846 ms (*SD* = 237 ms). The entire action took 1970 ms (*SD* = 514 ms), with the mug being off the surface of the table for an average of 1001 ms (*SD* = 369 ms).

2.3.1. Spatial manipulation of property

The spatial measures are taken at the time the mug reaches a maximum height; we therefore entered '*z*-max' as a covariate in the analysis of *x* and *y* position of the mug. Firstly, the mugs deviated to the right while being lifted. Mixed model analysis of this deviation along the *x*-axis showed this effect varied as a function of ownership, $F(2,18.0) = 9.52$, $p = .002$. The Experimenter's mug was displaced further along this axis (13.7 mm) relative to the Participant's mug (11.5 mm, $t(18.2) = 4.31$, $p < .001$) and the Unowned mug (11.7 mm, $t(18.2) = 3.34$, $p = .004$). Participants drew each of the mugs towards their body (i.e. along the *y*-axis). The effect of ownership on '*y* position at *z*-max' did not reach significance, $F(2,17.9) = 2.63$, $p = .100$. Nevertheless, contrasts revealed that participants brought their own mug closer towards themselves (19.5 mm along the *y*-axis) than the Experimenter's mug (17.3 mm, $t(16.9) = 2.27$, $p = .037$, see Fig. 2a), while the contrast between Participant's mug and Unowned mug (16.9 mm) was non-significant, $t(18.3) = 1.48$, $p = .16$. This is an intriguing pattern of data that shows the mug's lift trajectory depends upon who owns it. Note that the experimenter was seated to the participant's right during the experiment, which means that when considering the x and y deviation together, these mugs drifted slightly towards their owner.

The drift of their own mug closer towards themselves may reflect the over-learned motor experience of bringing that particular mug to their mouths to drink from it. In considering the deviation along the *x* axis, it is a beguiling conclusion to draw that the Experimenter's mug drifts towards its owner. Because the Experimenter was only ever to the right of the Participant, however, for now we interpret this hypermetric movement to the right as an indication of a tendency to avoid bringing an other-owned mug towards oneself. These displacement measures, in particular '*x* position at *z*-max,' are very strong indicative evidence of a degree of influence of ownership in the control of simple hand-object interactions. Overall, we bring our own objects towards us, and move objects that are owned by someone else away from our body.

2.3.2. Dynamic manipulation of property

We were also interested in the forces that the participants spontaneously applied to the mugs. We measured this by calculating the maximum acceleration of the mug during lift, and maximum deceleration during descent towards the surface of the table (see Fig. 2b). There was an effect of ownership on maximum acceleration, $F(2,36) = 9.44$, $MSe = 0.241$, $p < .001$, $\eta_p^2 = .34$, due to a greater

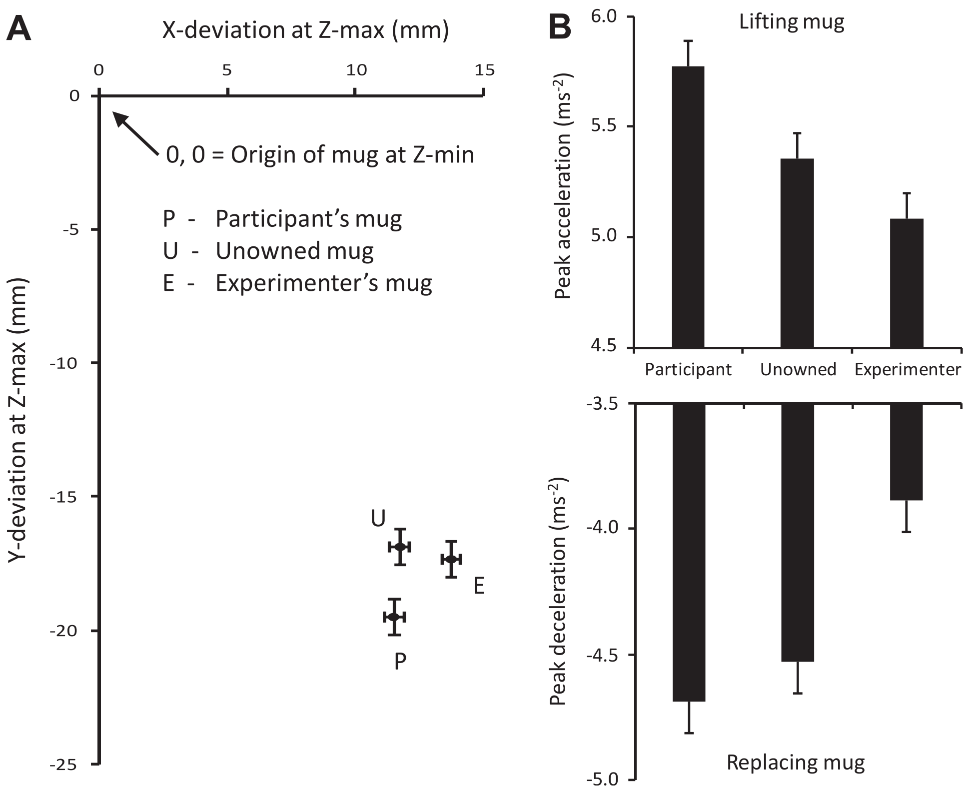

Fig. 2. Panel A: Graph illustrating the *x* (left–right) and *y* (toward-away) positions of the mug at the maximum mug height (z = 184 mm,190 mm, 195 mm for Unowned, Experimenters and Participants respectively) attained during lift phase of the action, for each mug type relative to the starting position on the table (i.e. $x = 0$, $y = 0$, $z = 0$). Panel B: Maximal acceleration of the mug during the lift phase, and maximal deceleration during the replace phase for each mug. Error bars in both panels denote standard error of the mean for within-subjects effects (Loftus & Masson, 1994).

average maximum acceleration while lifting one's own mug (5.77 ms^{-2}) than the Unowned mug (5.36 ms^{-2}, $t(18) = 2.67$, $p = .016$, $d = 0.61$) and the Experimenter's mug (5.09 ms^{-2}, $t(18) = 3.76$, $p = .001$, $d = 0.86$). Similarly, the deceleration during replacement ANOVA was significant, $F(2,36) = 11.1$, $MSe = 0.306$, $p < .001$, $\eta_p^2 = .38$. This was due to lower maximal deceleration of the Experimenter's mug (3.89 ms^{-2}) compared with the Unowned mug (4.53 ms^{-2}, $t(18) = 2.99$, $p = .008$, $d = 0.69$) and the Participant's mug (4.69 ms^{-2}, $t(18) = 4.82$, $p < .001$, $d = 1.11$). Therefore, when lifting and replacing a mug, participants spontaneously subjected their own property to greater force than when interacting with the Experimenter's property. This pattern of data is best explained by the notion that the motor system exerts more care when interacting with others' property than with one's own, despite the fact that the action-relevant physical properties (i.e. mass, shape and volume) of each object are identical.

3. Experiment 2

The first experiment provided initial evidence that our physical interactions with objects can be affected by the knowledge that the object has an owner. With the same participants, we investigated the automatic evocation of action towards self-owned vs. other-owned mugs using a compatibility task. Even this highly automatic effect might be modulated by a socio-emotional variable such as ownership. We therefore hypothesise that in Experiment 2 these motor-priming effects may be boosted for one's own mug but suppressed for objects owned by another. That is, the compatibility effect would be larger for the participant's own mug and smaller for the Experimenter's mug. This would provide converging evidence, from a different paradigm, for our general thesis that the visuomotor system represents knowledge of property.

3.1. Method

3.1.1. Stimuli

Photographs of each mug with their handles pointing left and right (90°) were edited to make two versions of each picture with a semi-transparent green or red patch placed over the mug handle. Each stimulus was presented life-size, with a black background, on a monitor placed 30 cm away. For a given participant, their stimuli would comprise the Participant's mug, the Experimenter's mug, an Unowned mug and two randomly-selected mugs that had been decorated by other participants (i.e. 'Other-owned' mugs). These mugs introduced variety into the task, to take focus away from the mugs that the participants had been using in Experiment 1. It is critical to note that we never made it explicit that these 'Other-owned' mugs were the property of other people. The experimenter simply stated that 'they would see some decorated mugs that they had not seen before'. That is, we only made ownership explicit with regard to the Experimenter's mug.

Hence, for each participant, there were five mugs, each presented in two orientations and each with two coloured handles (twenty stimuli). Responses were made with the 'z' (left) and 'm' (right) keys of a standard keyboard.

3.2.1. Procedure

On each trial, a white central fixation cross appeared (1.5 x 1.5 cm) for 1000 ms before the mug. The mug remained onscreen until the participant made a response. This was followed by a 250 ms inter-trial interval. We instructed participants to maintain fixation and to respond to the colour of the mug handle as quickly and accurately as possible. The mug would have the handle pointing to the left or right, but we impressed upon the participants to ignore stimulus orientation and respond only to the colour. Half the participants responded to red handles with the left key and green handles with the right key. We gave the remaining participants the reverse response assignments. A tone sounded in the event of an incorrect response. Participants completed 400 trials over four blocks. We presented each stimulus equally often and it was selected randomly on each trial. Hence, for each mug, there were forty compatible and forty incompatible trials. Trials from the two 'Other-owned' mugs were collapsed into one level. The experiment took 15 min and was completed immediately after Experiment 1.

3.2.2. Design

There were two within-subjects factors. 'Compatibility' described whether the side of the handle of the mug was the same as the correct response side (Compatible) or the opposite side (Incompatible). The factor 'Mug' had four levels determined by the owner of each stimulus, 'Participant', 'Experimenter', 'Other' and 'Unowned'. Mean correct reaction time for each cell, along with percent error rates were analysed.

3.3. Results and Discussion

Technical failure led to the loss of one participant's data; henceforth, $n = 18$. Errors were infrequent (3.1% of trials) and a Mug Type (4) x Compatibility (2) repeated-measures ANOVA revealed no significant effects. Reaction time outliers were removed (3*SD* above or below the participant's mean RT; 1.8% of trials) prior to calculation of mean RT for correct trials in each condition for each participant. The main effect of 'Mug' was significant, $F(3,51) = 2.84$, $MSe = 931$, $p = .047$, $\eta_p^2 = .14$, with overall colour decision responses being quickest for Unowned mug (556 ms) and slowest for the Participant's mug (577 ms). The main effect of 'Compatibility' was also significant, $F(1,17) = 11.2$, $MSe = 1694$, $p = .004$, $\eta_p^2 = .40$, due to faster RTs on Compatible compared with Incompatible trials (555 ms vs. 578 ms), replicating the classic S-RC effect. Critically, the 'Mug Type' x 'Compatibility' interaction was also significant, $F(3,51) = 4.26$, $MSe = 507$, $p = .009$, $\eta_p^2 = .20$. The source of this interaction was established with paired-samples *t*-tests, comparing RTs in Compatible trials with RTs in Incompatible trials for each Mug Type. Although the Participant's Mug (35 ms, $t(17) = 4.42$, $p < .001$, $d = 1.04$), the Unowned Mug, (33 ms, $t(17) = 2.92$, $p = .009$, $d = 0.69$), and the Other-Owned Mugs (23 ms, $t(17) = 2.56$, $p = .020$, $d = 0.60$) elicited significant S-RC effects, the Experimenter's Mug did not, (1 ms, $t(17) = .13$, $p = .90$, $d = 0.03$). This S-RC effect was significantly weaker than the effects elicited by each of the other mug types (Participant's, Other and Unowned, t's > 2.4, p's < .026) (see Fig. 3b). In effect, the visuomotor system is blind to the affordances of other people's objects.

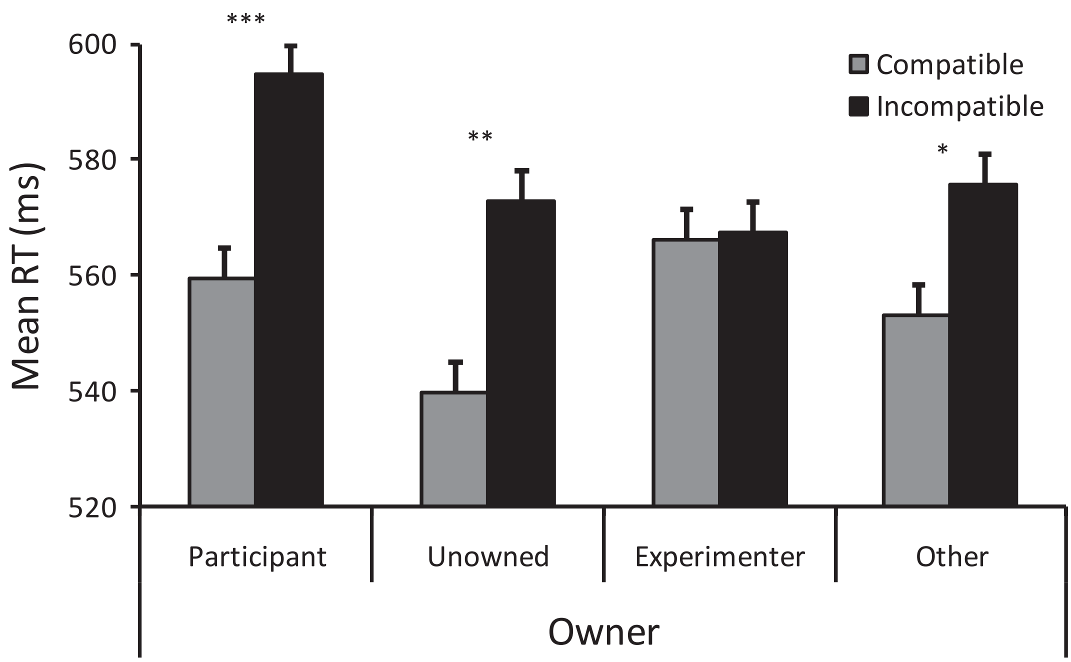

Fig. 3. Graph illustrating mean reaction times for each mug type and compatibility condition. Error bars denote standard error of the mean for within-subjects effects (Loftus & Masson, 1994).

It is conceivable, though unlikely, that some visual aspect of the particular design of the Experimenter's mug abolished the S-RC effects. To take account of this potential concern, ten new participants were recruited and completed the same task. Importantly, they neither owned, nor were aware of the ownership status of any mug. The only significant effect was 'Compatibility', $F(1,9) = 16.8$, $MSe = 998$, $p = .003$, $\eta_p^2 = .65$, due to a 29 ms S-RC effect. Critically, the Experimenter's mug elicited a highly significant effect (37 ms, $t(9) = 4.20$, $p = .002$, $d = 1.33$), which was significantly larger than that elicited in the main experimental sample who saw the identical visual stimulus, but knew the mug to be owned by the Experimenter (1 ms vs. 37 ms, $t(26) = 2.50$, $p = .019$, $d = 1.04$). It is therefore unlikely that a visual feature of the stimuli was responsible for the pattern of results in Experiment 2.

4. General discussion

Taken together, these findings are consistent with the idea that ownership is taken into account by the visuomotor system during object-oriented action. In Experiment 1 we showed that participants had a tendency to move the Experimenter's mug further to the right and with a lower maximum in-flight acceleration as compared to the other mugs. This pattern of results may reflect a reluctance to interact with, and an extra degree of care when manipulating, other peoples' possessions. In Experiment 2, we demonstrated that the compatibility effect evoked for lateralised stimuli is abolished for the Experimenter-owned mug. This striking result suggests that even at the initial stages of action representations – without overt action towards a physical object – the visuomotor system is sensitive to information about the ownership status of the object.

It is clear that the concept of ownership is a complex convergence of multiple interacting facets, such as memory (e.g. Cunningham et al., 2008), preference (Huang, Wang, & Shi, 2009), and visuomotor experience. A possible alternative explanation of some of our data may be that practice or familiarity accounts for stronger force applied to one's own mug, and for why one might draw it closer towards the body. This cannot explain, however, why the Experimenter's mug was drawn significantly further to the right during lifting. Nor can this account explain why S-RC effects were absent only for the Experimenter's mug. Increased valuation of one's own mug also cannot adequately account for any of the effects that relate to the objects owned by the experimenter; 'mere ownership' and 'endowment' effects focus on how we value self-owned objects alone. Indeed, the overall pattern of our data suggests that the motor system is highly tuned to detecting and avoiding interaction with objects owned by a known other, perhaps more than potentiating action towards objects that are self-owned. Therefore, the most parsimonious overall explanation of our data is that the concept of ownership is to some extent represented in the action system, and can influence our naturalistic (Experiment 1) and indirect (Experiment 2) interactions with property. This is consistent with growing assertions in the field that action and social context are entwined (Borghi & Cimatti, 2010; Georgiou, Becchio, Glover & Castiello, 2007; Sebanz, Bekkering, & Knoblich, 2006). As such, it is reasonable to suggest that ownership, as a social construct, may be to some extent embodied in the visuomotor system. One could even be tempted to speculate that owning an object might eventually prove to be somewhat similar to body-ownership (e.g. Blakemore & Frith, 2003; Gallagher, 2000), given the inextricable link between the self and property (James, 1890).

Still, we are mindful that our data speaks more strongly towards an inhibition of action involving others' possessions rather than a facilitation of action towards self-owned items. This may reflect the role of social norms associated with avoiding other people's property to prevent conflicts within relationships, but also of avoiding exposure to contaminants in vessels that have been drunk from by others. Further, presence of the owner, and whether explicit knowledge of ownership status is necessary to elicit these effects are important research questions. Future work will doubtlessly further elucidate the cognitive basis of how our behaviour is guided through a world in which almost all artefacts are owned by individuals or organisations. Perhaps then, the 'disquiet' to which Anaxagoras hinted might be at least better understood, if not tempered.

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