

Culture Modulates Implicit Ownership- Induced Self-Bias in Memory

Samuel Sparks¹, Sheila J. Cunningham² and Ada Kritikos¹

¹School of Psychology, University of Queensland

²School of Social & Health Sciences, University of Abertay

Corresponding author:

Samuel Sparks

School of Psychology

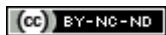
University of Queensland

St Lucia 4072

Tel: +61 421 192 379

samuel.sparks@uq.net.au

This is the accepted manuscript © 2016, Elsevier
Licensed under the Creative Commons Attribution-NonCommercial-
NoDerivatives 4.0 International: <http://creativecommons.org/licenses/by-nc-nd/4.0/>



The published article is available from doi:

[10.1016/j.cognition.2016.05.003](https://doi.org/10.1016/j.cognition.2016.05.003)

Abstract

1
2 The relation of incoming stimuli to the self implicitly determines the allocation of cognitive
3 resources. Cultural variations in the self-concept shape cognition, but the extent is unclear
4 because the majority of studies sample only Western participants. We report cultural
5 differences (Asian versus Western) in ownership-induced self-bias in recognition memory
6 for objects. In two experiments, participants allocated a series of images depicting
7 household objects to self-owned or other-owned virtual baskets based on colour cues
8 before completing a surprise recognition memory test for the objects. The 'other' was either
9 a stranger or a close other. In both experiments, Western participants showed greater
10 recognition memory accuracy for self-owned compared with other-owned objects,
11 consistent with an independent self-construal. In Experiment 1, which required minimal
12 attention to the owned objects, Asian participants showed no such ownership-related bias
13 in recognition accuracy. In Experiment 2, which required attention to owned objects to
14 move them along the screen, Asian participants again showed no overall memory advantage
15 for self-owned items and actually exhibited higher recognition accuracy for mother-owned
16 than self-owned objects, reversing the pattern observed for Westerners. This is consistent
17 with an interdependent self-construal which is sensitive to the particular relationship
18 between the self and other. Overall, our results suggest that the self acts as an organising
19 principle for allocating cognitive resources, but that the way it is constructed depends upon
20 cultural experience. Additionally, the manifestation of these cultural differences in self-
21 representation depends on the allocation of attentional resources to self- and other-
22 associated stimuli.

23

24 **Keywords:** self; cross cultural differences; implicit memory; individual differences; memory;
25 self reference effect

1 **1. Introduction**

2 Cognition research over the last decade or so has provided an increasingly nuanced
3 understanding of how perception, attention and memory operate. It is clear that both the
4 physical properties of stimuli and the relation of stimuli to the self, the social context, and
5 individual differences are important considerations (e.g., Bayliss & Kritikos, 2011; Caudek,
6 2014; Constable, Kritikos, Lipp, & Bayliss, 2014; He, Sebanz, Sui, & Humphreys, 2014;
7 Humphreys & Sui, 2015). Culture is a major source of individual differences, particularly with
8 respect to representation of self and social context (Heine & Ruby, 2010; Markus &
9 Kitayama, 2010). Until recently, the field of cognitive science predominantly recruited
10 Western samples, often without noting participants' cultural background or ethnicity
11 (Arnett, 2008; Henrich, Heine, & Norenzayan, 2010). There is now growing interest in how
12 cultural experience shapes cognition, particularly with respect to self-related cognition (e.g.,
13 Chiao et al., 2009; Han et al., 2013; McKone et al., 2010; Zhu, Zhang, Fan, & Han, 2007). In
14 two experiments, we compare bias in recognition of self-owned versus other-owned objects
15 in Western and Asian participants, and show that ownership-related cognitive biases differ
16 substantially across these broad cultural categories.

17 *1.1 Interdependent and independent self-construal*

18 Markus and Kitayama (1991; 2010) describe the self as a fundamental schema that
19 organises and regulates mental processes and behaviour, both explicitly and implicitly. As
20 such, the self attunes the individual to the environment and stores patterns of behaviour for
21 interacting with it. Cultural experience shapes the representation of self, and this results in
22 cultural differences in tasks involving self-related cognition (Markus & Kitayama, 2010).

23 Cross-cultural research has highlighted the relevance of independent and
24 interdependent patterns of self-construal for cognition (for reviews, see Heine & Ruby,
25 2010; Markus & Kitayama, 2010). Independent self-construal, which is emphasised in
26 Western cultures, represents the self as distinct and different from others, with cognition
27 and behaviour reflecting this strong self-other separation (Markus & Kitayama, 1991).
28 Interdependent self-construal, typically valued in East Asian and South Asian cultures,
29 represents the self in terms of interconnectedness with others, especially close others such
30 as family (Markus & Kitayama, 1991).

31 It is important to note that particular individuals within Western and Asian cultures
32 vary in the extent to which their self-representation is independent or interdependent

1 (Markus & Kitayama, 1991). Nevertheless, broadly classifying cultures as ‘Western’ and
2 ‘Asian’ has proved useful for examining differences in general patterns of self-
3 representation (e.g., Masuda & Nisbett, 2006; see Kitayama & Uskul, 2011 for review), and
4 this is the approach we take in this paper. This enables identification of overarching patterns
5 in the way differences in self-representation affect cognition, which can be followed by
6 more fine-grained investigations.

7 *1.2 The self-reference effect in memory*

8 Cultural differences have been shown for the self-reference effect in memory (Huff,
9 Ligouri, & Gutchess, 2015; Huff, Yoon, Lee, Mandadi, & Gutchess, 2013). Generally,
10 participants in self-referential memory paradigms first evaluate sets of words with reference
11 to the self or another person (Klein, 2012). Across both Western and Asian cultures,
12 performance on surprise recognition or recall memory tests is generally superior for self-
13 associated words compared with words associated with a stranger (Kuiper & Rogers, 1979;
14 Symons & Johnson, 1997; Zhu & Zhang, 2002; Zhu et al., 2007). In Western participants, a
15 self-association advantage remains across different other-referents, although the
16 magnitude of the effect can be weaker when the self is contrasted with a close, familiar
17 other such as the mother (Symons & Johnson, 1997; Zhu & Zhang, 2002; Zhu et al., 2007; cf.
18 Bower & Gilligan, 1979). This is consistent with a strong self-other differentiation even for
19 highly self-relevant others. In contrast, Chinese participants display comparable memory
20 performance for both self- and mother-referenced words, both of which are recognised
21 better than words related to a non-close other (Zhu & Zhang, 2002; Zhu et al., 2007). This is
22 consistent with a dominance of interdependent self-construal in Chinese participants in
23 which the self is strongly connected with close others.

24 Behavioural differences between cultures in self-referential memory are reflected in
25 variations in neural activity in the medial prefrontal cortex (MPFC; Zhu et al., 2007), an area
26 implicated in self-referential processing (Kelley et al., 2002; Northoff et al., 2006). Zhu et al.
27 (2007) showed that in Western participants, MPFC activity was greater when judging how
28 words related to the self, compared with both the mother and a stranger. Chinese
29 participants, by contrast, showed comparable MPFC activity for self and mother judgments
30 compared with stranger judgements (Zhu et al., 2007). Thus, there is converging behavioural
31 and neural evidence for cultural variation in self-referential processing.

32

1 *1.3 Perceptual self-association effects*

2 The close equivalence of self- and mother-associated stimuli in memory tasks for Asian
3 participants does not hold across all cognitive processes. Recently, Sui, He, & Humphreys
4 (2012) introduced a paradigm showing enhanced perceptual matching speed for self-
5 associated stimuli. Participants learn to associate simple geometric shapes with the self or
6 others (e.g., “The triangle is you; the square is your mother.”). In a subsequent task,
7 participants made speeded judgements of whether shape-label pairs (e.g., square/you)
8 matched the previously learned associations. A sample of UK college students showed faster
9 response time and higher sensitivity to self-match pairs than to mother-match pairs or
10 stranger-match pairs. Sui, Sun, Peng, and Humphreys (2014) later reported comparable self-
11 over-mother bias in a sample of Chinese participants, in contrast to the self-mother
12 equivalence in the self-referential memory performance reported by Zhu et al. (2007).

13 This disparity suggests the manifestation of cultural differences in self-related
14 cognition depends on how the self-other distinction is operationalised in a task, and as a
15 consequence, which cognitive processes the task engages. In typical word-based self-
16 referential memory tasks (see Klein, 2012, for review), including Zhu et al.’s (2007), self- and
17 other-referenced stimuli are words rich in semantic content, which must be explicitly
18 evaluated with respect to self and others. In contrast, the perceptual matching task used by
19 Sui and colleagues (Sui et al., 2012, 2014) requires simple speeded match/mismatch
20 judgements, and the self- and other-relevant stimuli (geometric shapes) contain little
21 inherent semantic content. Thus, one possibility is that the self-over-mother distinction in
22 the perceptual matching task reflects a basic, low-level self-other differentiation common to
23 both independent and interdependent self-construal. Cultural differences in self-related
24 processing may emerge when a task involves higher-level semantic processing. More work is
25 needed to determine the extent and nature of cultural differences in self-related cognition.

26 *1.4 Owned objects as extensions of the self*

27 Object ownership paradigms provide a useful tool for investigating how the self
28 structures cognition (Constable et al., 2014; Cunningham, Turk, Macdonald, & Macrae,
29 2008), and how cultural experience might shape this. In human society, objects are
30 pervasively associated with the self and others via ownership. It has been proposed that
31 self-owned objects are incorporated into the self-representation as part of an *extended self*
32 (Belk, 1988, 2014), and thus self-related cognitive biases extend to these objects (Beggan,

1 1992; Kim & Johnson, 2012, 2015). If this is so, differences in self-construal should modulate
2 ownership-related cognitive effects. The processing of self-owned objects in Western
3 participants shows evidence of the strong self-other distinction associated with independent
4 self-construal (Constable, Kritikos, & Bayliss, 2011; Cunningham et al., 2008; Maddux et al.,
5 2010). If cultural experience shapes self-representation, we should find ownership-related
6 effects consistent with interdependent self-construal in cultures where this representation
7 is favoured.

8 Research on ‘endowment effects’ associated with ownership has already suggested
9 that cultural differences in self-representation shape ownership-related cognition. The
10 endowment effect refers to the tendency to value self-owned objects more than other-
11 owned or unowned objects (Kahneman, Knetsch, & Thaler, 1991; Thaler, 1980), and is very
12 robust in Western samples (Maddux et al., 2010; for review, see Morewedge & Giblin,
13 2015). Maddux et al. (2010), however, showed weaker endowment effects in East Asian
14 compared with Western participants. This is consistent with the reduced emphasis on
15 positive self-distinction (over and against others) associated with interdependent self-
16 construal (Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997; Norasakkunkit & Kalick,
17 2002).

18 Additionally, Chinese participants display endowment effects of comparable size for
19 self-owned and mother-owned items, and the magnitudes of self- and mother endowment
20 effects are both predicted by MPFC activity (Feng, Zhao, & Donnay, 2013). Zhao, Feng, and
21 Kazinka (2014) further demonstrated endowment effects for friend-owned, lover-owned,
22 mother-owned objects with Chinese participants, but there was no endowment effect for
23 acquaintance-owned items. This is consistent with an interdependent self-construal for
24 Chinese participants, where self-related cognitive biases extend to close others who are
25 represented as strongly interconnected with the self.

26 *1.5 Ownership effects in recognition memory*

27 Ownership effects also emerge in tasks that do not necessarily require deliberate self-
28 or other-referential judgements or evaluative processing. Numerous studies demonstrate a
29 memory advantage even for transiently and arbitrarily self-owned versus other-owned
30 items in Western participants (Cunningham, Brady-Van den Bos, & Turk, 2011; Cunningham
31 et al., 2008; Turk et al., 2013; Van den Bos, Cunningham, Conway, & Turk, 2010). In these
32 paradigms, participants view a series of objects sequentially and allocate them to one of

1 two baskets based on cues (e.g., a colour border around object). The task description states
2 that one basket belongs to the participant and the other to a different person (real or
3 imaginary). On a subsequent surprise recognition memory test, recognition performance is
4 superior for objects allocated to the self-owned basket compared with the other-owned
5 basket. Additionally, self-owned and other-owned objects evoke differential MPFC activity
6 both during initial assignment of objects to owners (Kim & Johnson, 2012) and when the
7 objects reappear later (Kim & Johnson, 2014).

8 The self-owned advantage is particularly noteworthy because it is not strictly
9 necessary for participants to attend to the ownership status of the objects at the encoding
10 phase. The task description informs participants that one basket belongs to them and the
11 other belongs to another person, but they can ignore this fact and successfully sort the
12 items into appropriate baskets based entirely on visual cues (e.g., allocate objects with a
13 blue label to the blue basket). Thus, processing the objects in a self-referential way is
14 unnecessary to perform the task at both the encoding stage and during the recognition
15 memory test. This raises two possible, and not mutually exclusive, sources of the self-owned
16 memory advantage in this paradigm. One is that participants spontaneously and consciously
17 engage in deliberate self- and other-referential semantic processing during the object
18 allocation task, in excess of the minimum task requirements. The other is that, as a result of
19 the description of the baskets as self- and other-owned, assigning an object to the self-
20 owned basket implicitly and unconsciously associates it with the self and enhances its
21 representation in memory.

22 Importantly, Turk et al. (2013) have shown that dividing attention during the object
23 allocation stage can abolish the self-owned memory advantage, which suggests that the
24 processing underpinning the self-owned advantage requires cognitive resources beyond
25 those needed to merely allocate the objects correctly. This seems most consistent with the
26 notion that the self-owned advantage arises from resource-intensive conscious, deliberate
27 semantic processing. Given that the clearest evidence of cultural variability in self-related
28 cognition comes from tasks involving deliberate semantic or evaluative processing (e.g.,
29 Maddux et al., 2010; Zhu et al., 2007), we would expect equivalent effects to emerge for the
30 self-owned memory advantage. Neuroimaging studies, however, suggest that although both
31 word-based and ownership-based tasks are related to mPFC activity, they nevertheless
32 evoke qualitatively distinguishable patterns of activity in this region (compare Kelley et al.

1 2002 and Turk, van Bussel, Waiter, & Macrae. 2011). This suggests that self-referential
2 processing in the ownership task is not directly equivalent to word-based paradigms. Thus,
3 it represents a means to develop a more nuanced picture how cultural difference manifest
4 in self-related processing.

5 **2. Experiment 1**

6 Investigating ownership-related memory biases in non-Western participants may shed
7 light on the nature of the self-owned bias in recognition memory, and on the conditions
8 under which cultural differences in self-related cognition emerge. Given that both Western
9 and Asian participants have shown advantages for self-related stimuli relative to stranger-
10 related stimuli in other paradigms (Zhu et al., 2007), we expect that both these groups will
11 show better recognition memory performance for self-owned objects compared with
12 stranger-owned objects. Western participants, with primarily independent self-construal,
13 should also show a self-owned advantage compared with close others. If the self-owned
14 advantage is affected by cultural experience, Asian participants should show reduced or
15 absent distinction in memory performance between self-owned and close-other-owned
16 objects. To test this, in Experiment 1 we adapted the shopping task used by Van den Bos et
17 al. (2010). Participants with Western and Asian cultural backgrounds allocated virtual
18 objects to a self-owned or other-owned basket. The identity of the 'other' was either a
19 stranger or a close and familiar other (closest friend or mother). Close friend and mother
20 were chosen as 'close others' for comparability with previous studies (Feng et al., 2013; Sui
21 et al., 2012; Zao et al., 2014; Zhu et al., 2007). It is likely that participants have a longer-
22 standing relationship with their mother compared with a close friend, but given the
23 voluntary element of friendship participants may represent their closest friend as more
24 intimate than their mother, especially in an undergraduate population. We therefore
25 included both of these referents to test the generalisability of any close-other related
26 effects.

27 *2.1 Method*

28 *2.1.1 Participants.*

29 Students enrolled in an undergraduate psychology course at a large Australian
30 university were given the opportunity to voluntarily complete the experiment during class in
31 computer labs over three days, and 267 participated and provided data. The study was
32 approved by the University of Queensland ethical review process and complied with the

1 Declaration of Helsinki. After application of predetermined inclusion criteria (see below),
2 140 Western participants (98 females, 42 males) aged 17 to 53 years ($M = 21.45$, $SD = 5.99$)
3 and 61 Asian participants (47 female, 14 male) aged 19 to 37 years ($M = 20.52$, $SD = 3.32$)
4 were included in the analyses. Preliminary checks indicated that gender did not vary as a
5 function of cultural group. We report the results with South, East, and Southeast Asian
6 participants included in the Asian group. Excluding South Asian participants did not alter the
7 pattern of results.

8 In the final sample, 86% of Western participants reported living in Australia for 10
9 years or more, and 7% reported 1 year or less ($M = 18.36$ years, $SD = 7.82$ years). Only 18%
10 of Asian participants reported at least 10 years' residence and 63% reported 1 year or less
11 ($M = 4.32$ years, $SD = 6.88$ years). In the mother condition, 87% of Western participants and
12 88% of Asian participants reported being in contact with their mother at least weekly (in-
13 person or electronically). In the close friend condition, 86% of Western participants and 71%
14 of Asian participants reported being in contact with their closest friend at least weekly.

15 *2.1.2 Procedure & Stimuli.*

16 Testing occurred in groups across 16 sessions supervised by an experimenter (the class
17 tutor) and stimuli were presented using E-Prime 2.0 software (Psychology Software Tools,
18 Pittsburgh, PA). Participants received initial instructions before completing an object
19 allocation task, a recognition memory test, exploratory questionnaires, and demographic
20 questions. Demographic questions assessed age, gender, ethnicity, home country, previous
21 country of residence, and amount of contact with the close other (if applicable).

22 Initially, each participant was instructed to imagine either someone they had never
23 met named John, their closest same-gender friend, or their mother. The type of imagined
24 other was randomly assigned for each participant, but, for ethical reasons, participants were
25 given the option to opt-out being selected to think about their mother. In the close friend
26 and mother conditions, participants were asked to indicate their friend's/mother's favourite
27 hobby, television show, and music to facilitate engagement with the task.

28 In the object allocation task, participants sorted each of 100 objects into red and blue
29 baskets belonging to themselves and the other (stranger, close friend, or mother). Baskets
30 were positioned to the left and right of the screen. Before the task began, participants were
31 informed they would complete a shopping task in which they would place objects in baskets
32 that belonged to them and the other. The colour corresponding to the self and the side on

1 which the baskets appeared was randomised for each participant. Half the objects were
2 allocated to the participant (self-owned) and half to the other (other-owned). To achieve
3 this, the program randomly allocated one of three 50-object lists to be self-owned, other-
4 owned, or unowned (used later in the surprise recognition memory test). This item set was
5 used in a previous study (Van den Bos et al., 2010), and contained objects typically available
6 in United Kingdom shopping centres. Each set was matched for item type (e.g., fruit,
7 appliances).

8 On each trial, an object appeared in the centre of the screen for 1,500 ms, after which
9 a red or blue border appeared around the object for a further 1,500 ms (see Figure 1).
10 Participants' task was to assign the object to the appropriate basket with a key press based
11 on the coloured border. The object remained visible after the key press response to
12 standardise visual exposure. After the time to respond elapsed, the object disappeared and
13 a 500 ms intertrial interval (baskets without any shopping item) preceded the next trial. Trial
14 order was randomised for each participant.



15
16 **Fig. 1.** Object allocation phase showing participant's and other's basket and allocation
17 cue surrounding object.

18 In the surprise recognition memory test, each object from the allocation task
19 appeared in random order on a blank background, along with 50 new objects as foils. Items
20 were presented on a blank background. Participants had 1,500 ms in which to indicate they
21 did or did not recognise the object from the allocation task, by responding on the keyboard
22 with the O (recognise) and P (do not recognise) keys. After the participant responded or the
23 time elapsed, a blank 1,000 ms intertrial interval preceded the next trial.

24 *2.1.3 Inclusion Criteria*

25 Participants were included in the analyses if they met the following predetermined
26 criteria: (a) at least 95% accuracy in the object allocation task, (b) at least 66% of responses
27 made in time for the recognition memory test, (c) ethnicity reported and classifiable as

1 either Western or Asian, and (d) willing to be randomly assigned to any condition (i.e., did
 2 not opt out of the mother condition). Criteria (a) and (b) were adopted to ensure that
 3 participants in the final sample had attended adequately to both the allocation task and
 4 memory test. Participants were classified as Western if they reported their ethnicity as
 5 Caucasian, White, or from Western Europe (e.g., Scottish). Participants were classified as
 6 Asian if they reported their ethnicity as Asian or as a specific South, Southeast, or East Asian
 7 nation. Five participants listed their ethnicity as 'Australian'. Each of these participants listed
 8 English as their only known language and Australia as their country of birth so they were
 9 included in the Western group in the analysis (exclusion of these participants did not affect
 10 the pattern of results). Four Western and two Asian participants were excluded for opting
 11 out of the mother condition. The final sample consisted of 201 participants after the
 12 exclusion of 66.

13 2.2 Results

14 We computed each participant's corrected hit rate for self-owned and other-owned
 15 items separately by subtracting false alarm rate from uncorrected hit rate for each
 16 condition. Thus, a corrected hit rate of 1.00 represents perfect performance, whereas 0.00
 17 represents guessing (hit rate equals false alarm rate). Table 1 shows uncorrected hit rates
 18 and false alarm rates for each group in each condition.

19 Table 1.

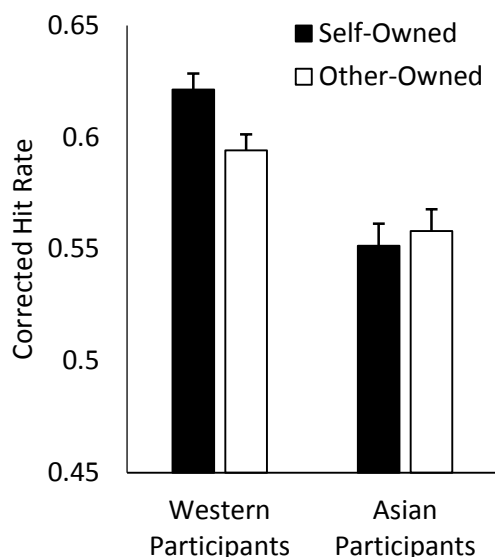
20 *Mean Hit Rates and False Alarm Rates for Asian and Western Participants Experiment 1.*

	Asian Participants			Western Participants		
	Stranger Condition	Mother Condition	Friend Condition	Stranger Condition	Mother Condition	Friend Condition
Self-Owned Hit Rate	0.65 (0.16)	0.64 (0.12)	0.66 (0.13)	0.71 (0.17)	0.71 (0.14)	0.72 (0.12)
Other-Owned Hit Rate	0.66 (0.17)	0.64 (0.11)	0.67 (0.14)	0.67 (0.16)	0.70 (0.16)	0.69 (0.12)
False Alarm Rate	0.09 (0.06)	0.10 (0.07)	0.12 (0.09)	0.09 (0.08)	0.08 (0.07)	0.10 (0.09)
<i>n</i>	24	16	21	42	48	50

Note: Standard deviations shown in parentheses.

1 We submitted corrected hit rates to a repeated measures analysis of variance
2 (ANOVAs) with object ownership (self-owned or other-owned) as a within-participants
3 variable and other identity (stranger, close friend, or mother) and culture (Western or Asian)
4 as between-participants variables. The main effect of object ownership approached
5 significance, with a trend toward higher corrected hit rates for self-owned objects ($M = 0.60$,
6 $SD = 0.17$) than other owned objects ($M = 0.58$, $SD = 0.17$), $F(1,195) = 3.05$, $p = .083$, $\eta_p^2 =$
7 $.02$. The main effect of culture was significant, with a higher corrected hit rate for Western
8 participants ($M = 0.61$, $SD = 0.17$) compared with Asian participants ($M = 0.55$, $SD = 0.15$),
9 $F(1,195) = 4.49$, $p = .035$, $\eta_p^2 = 0.04$. These effects, were, however, qualified by a significant
10 object ownership by culture interaction, $F(1,195) = 6.87$, $p = .009$, $\eta_p^2 = 0.03$. Follow-up
11 comparisons revealed that Western participants showed a significantly higher corrected hit
12 rate for self-owned ($M = 0.62$, $SD = 0.17$) items compared with other-owned items ($M =$
13 0.59 , $SD = 0.18$), $t(139) = 3.81$, $p < .001$, whereas Asian participants showed comparable
14 performance on self-owned ($M = 0.55$, $SD = 0.15$) and other-owned ($M = 0.56$, $SD = .16$)
15 objects, $t(60) = -0.67$, $p = .507$. The main effect of other identity ($F(2,195) = 0.10$, $p = .907$),
16 owner by other identity interaction ($F(2,195) = 0.27$, $p = .760$), culture by other identity
17 interaction ($F(2,195) = 0.19$, $p = .830$) and owner by culture by other identity interaction
18 ($F(2,195) = 1.14$, $p = .322$) were nonsignificant. Overall, this pattern suggests Western
19 participants showed a bias in recognition memory accuracy in favour of self-owned items
20 over other owned items, whereas, as a group, Asian participants performed equally for all
21 objects (see Figure 2).

22



1

2 **Fig. 2.** Corrected hit rates for self-owned and other-owned objects as a function of cultural
 3 background. Error bars denote one standard error of the mean difference within each
 4 cultural group.

5 *2.3 Discussion*

6 Experiment 1 provides, to our knowledge, the first evidence that cultural background
 7 can modulate the effect of object ownership on recognition memory performance. For
 8 Western participants, we replicated the self-over-stranger recognition memory advantage
 9 reported in previous studies (Cunningham et al., 2008, 2011; Turk et al., 2013; Van den Bos,
 10 et al., 2010). Additionally, Western participants also showed enhanced recognition accuracy
 11 for self-owned compared with objects belonging to both close others (mother/friend). In
 12 contrast, self-ownership did not enhance Asian participants' memory performance,
 13 regardless of whether it was contrasted with ownership by mother, close friend, or a
 14 stranger. Finally, Asian participants' overall recognition performance was significantly lower
 15 than Western participants'.

16 These results are consistent with cultural differences in self-construal. Western
 17 participants' self-owned advantage aligns with an independent self-construal involving
 18 strong self-other differentiation. The absence of an ownership-related bias in Asian
 19 participants is consistent with an interdependent self-construal, which represents the self as
 20 interconnected with, rather than distinct from, others. For the mother and closest friend
 21 conditions, this is consistent with previous studies using word-based self-referential
 22 memory paradigms (Zhu & Zhang, 2002; Zhu et al., 2007).

1 There are, however, two important caveats to this interpretation. First, Asian
2 participants showed lower overall recognition memory performance than Western
3 participants, which is not typical of similar self-association recognition memory paradigms
4 involving words (Zhu et al., 2007). This raises the possibility that some aspect of the task
5 made it relatively difficult for Asian participants compared with Western participants.
6 Second, Asian participants showed no advantage self-associated versus stranger-associated
7 objects, whereas Asian participants do show an advantage a self-versus-stranger advantage
8 in other self-association paradigms (Sui et al., 2012; Zhu & Zhang, 2002; Zhu et al., 2007). It
9 is possible that, if the task was more difficult for Asian participants, it was not sufficiently
10 sensitive to detect self-versus-stranger biases in their case.

11 There is evidence that Western participants direct attention to focal objects in a
12 different manner to Asian participants (Han & Northoff, 2008; Ketay, Aron, & Hedden, 2009;
13 Kitayama & Uskul, 2011). For example, in change-detection tasks, Caucasian Americans
14 show an advantage for focal object changes relative to contextual changes, whereas East
15 Asian participants detect contextual changes better than focal object changes (Masuda &
16 Nisbett, 2006; see also Boduroglu, Shah, & Nisbett, 2009). East Asian and Caucasian
17 American participants also show differential neural activity in object processing areas in
18 response to focal objects (Gutchess, Welsh, Boduroglu, & Park, 2006; Goh et al., 2007).
19 These differences suggest that Asian participants engage a relatively holistic attentional
20 strategy, which is more sensitive to context and background information and less focused
21 on central objects, compared with Western participants (Ketay et al., 2009; Kitayama &
22 Uskul, 2011; Masuda & Nisbett, 2001, 2006). In recognition memory for focal objects initially
23 presented on a background scene, East Asian participants compared with Caucasian
24 Americans show a greater recognition decrement when the background at test changes
25 (Chua et al., 2005; Masuda & Nisbett, 2001). Asian participants also spend comparatively
26 less time fixating on focal objects in the study phase (Chua et al., 2005). Additionally, Asian
27 participants can show relatively lower recognition accuracy for objects studied and tested
28 against a blank (black or white) background when presentation time is relatively brief in the
29 study phase (Gutchess et al., 2006; Millar, Serbun, Vadalía, & Gutchess, 2013). We suggest,
30 therefore, that if Asian participants (versus Western participants) in Experiment 1 allocated
31 fewer attentional resources to the focal objects in the object allocation task (i.e., encoding
32 phase), this might account for their lower overall recognition rate.

1 Additionally, the emergence of self-bias may be contingent on the allocation of
2 sufficient attentional resources to the self-associated object at encoding. This notion is
3 supported by Turk et al.'s (2013) findings that the self-owned advantage was abolished for
4 Western participants under conditions of divided attention. Thus, Asian participants' lack of
5 ownership-related memory bias in Experiment 1 may have been due to insufficient
6 allocation of attention to the focal object. This explanation is particularly relevant given that
7 in the object allocation task participants could attend to the coloured cues around the
8 objects to select the appropriate response button while ignoring the actual objects.

9 **3. Experiment 2**

10 In Experiment 2, we attempted to address the attentional explanation outlined above
11 by encouraging allocation of attention to the objects during the encoding phase. Whereas In
12 contrast to Experiment 1, which required no interaction with the object itself during the
13 object allocation phase, Experiment 2 required participants to 'move' the object across the
14 screen into to the correct owner's bag by holding down the appropriate arrow key. Success
15 on each allocation trial was contingent on moving the object fully into the correct bag,
16 which would end the trial. In addition, to increase power for the other identity
17 manipulation, we included only stranger and mother conditions in Experiment 2. If the more
18 interactive object allocation task successfully encourages attentional engagement with the
19 objects, this may trigger self- and other-referential processing for Asian participants. If so,
20 Asian participants should show a self-owned advantage in the stranger condition and not in
21 the mother condition, consistent with an interdependent self-representation. Western
22 participants should again show a non-specific self-owned advantage.

23 *3.1 Method*

24 *3.1.1 Participants*

25 A new sample of 325 participants was recruited in the same manner as Experiment 1.
26 Eleven participants (10 Western and 1 Asian) were excluded for opting out of the mother
27 condition. Thirty-three participants listed their ethnicity as 'Australian,' English as their only
28 known language, and Australia as their country of birth. As in Experiment 1, these
29 participants were included in the Western group, but the same general pattern of results
30 obtains if they are excluded. After application of the inclusion criteria (as in Experiment 1),
31 171 Western participants (50 male, 120 female, 1 unspecified gender) aged 18 to 45 years
32 ($M = 20.64$, $SD = 4.11$) and 74 Asian participants (26 male, 48 female) aged 18 to 29 years (M

1 = 20.36, $SD = 1.63$) were included in the analysis. We report results with South Asian, East
2 Asian, and Southeast Asian participants included in the Asian group, but exclusion of South
3 Asian participants did not alter the pattern of results.

4 In the final sample, 90% of Western participants reported living in Australia for 10
5 years or more, and 4% reported 1 year or less ($M = 18.33$ years, $SD = 6.35$ years). Of the
6 Asian participants, 40% reported at least 10 years' residence and 29% reported 1 year or
7 less ($M = 8.26$ years, $SD = 8.04$ years). In the mother condition, 82% of Western participants
8 and 85% of Asian participants reported being in contact with their mother at least weekly
9 (in-person or electronically).

10 3.1.2 Procedure & Stimuli

11 The close friend condition was removed from this experiment. Given that numbers of
12 Asian students are limited, we wanted to maximise power for the mother versus stranger
13 comparison, which has most successfully produced effects in previous studies (Chiao et al.,
14 2009; Sui, Zhu, & Chiu, 2007; Wang et al., 2012; Zhu & Zhang, 2002; Zhu et al., 2007). The
15 name of the stranger was changed from John (Experiment 1) to Lee in an attempt to use a
16 less gender- and culture-specific name. The mother condition was unchanged.

17 The object allocation task used the same item set as Experiment 1. The basket images
18 were replaced with images of red and blue canvas-style shopping bags. Bags were
19 positioned equidistant to the left and right of the centre of the screen such that they
20 opened towards the shopping objects. Each object appeared centrally for 1500 ms before
21 coloured bars onset above and below it to indicate to which bag it should be moved.
22 Participants used the left and right arrow keys to move the object into the appropriate bag.
23 If participants failed to initiate movement within 2000 ms of object onset or failed to move
24 the object into a bag within 5000 ms of movement initiation, the object would disappear
25 and the trial would end. Objects moved smoothly across the screen such that an
26 uninterrupted movement from the initial position into a bag lasted approximately 1670 ms
27 (exact timing depended on when movement initiation occurred relative to the refresh cycle
28 of the monitor). During the 500 ms intertrial interval, bags remained onscreen with no
29 object present.

30 The recognition memory test was identical to Experiment 1.

31

32

1 *3.2 Results*

2 Corrected hit rates were submitted to a repeated measures ANOVAs with object
 3 ownership (self-owned or other-owned) as a within-participants variable and other identity
 4 (stranger or mother) and cultural background (Western or Asian) as between-participants
 5 variables. Table 2 displays uncorrected hit rates and false alarm rates for each group in each
 6 condition.

7 Table 2.

8 *Mean Hit Rates and False Alarm Rates for Asian and Western Participants Experiment 2.*

	Asian Participants		Western Participants	
	Stranger Condition	Mother Condition	Stranger Condition	Mother Condition
Self-Owned Hit Rate	0.67 (0.13)	0.58 (0.14)	0.71 (0.15)	0.72 (0.13)
Other-Owned Hit Rate	0.64 (0.14)	0.62 (0.15)	0.70 (0.15)	0.70 (0.14)
False Alarm Rate	0.11 (0.10)	0.09 (0.07)	0.08 (0.06)	0.08 (0.07)
<i>n</i>	40	34	89	82

9 *Note:* Standard deviations shown in parentheses.

10 The main effect of ownership was nonsignificant, $F(1,241) = 0.24$, $p = .625$. There was
 11 a main effect of culture such that Western participants showed higher corrected hit rates
 12 ($M = 0.63$, $SD = 0.14$) than Asian participants ($M = 0.53$, $SD = 0.15$), $F(1,241)$, $p < .001$, $\eta_p^2 =$
 13 $.09$. The ownership by other identity interaction was significant, $F(1,241)$, $p = .013$, $\eta_p^2 = .01$,
 14 and the ownership by culture interaction was marginally significant, $F(1,241) = 3.04$, $p =$
 15 $.082$. These effects were qualified by a three-way ownership by culture by other identity
 16 interaction, $F(1,241) = 7.05$, $p = .008$, $\eta_p^2 = .03$. To follow up the three-way interaction
 17 (depicted in Figure 3), separate ownership by other identity ANOVAs were conducted for
 18 each cultural group.

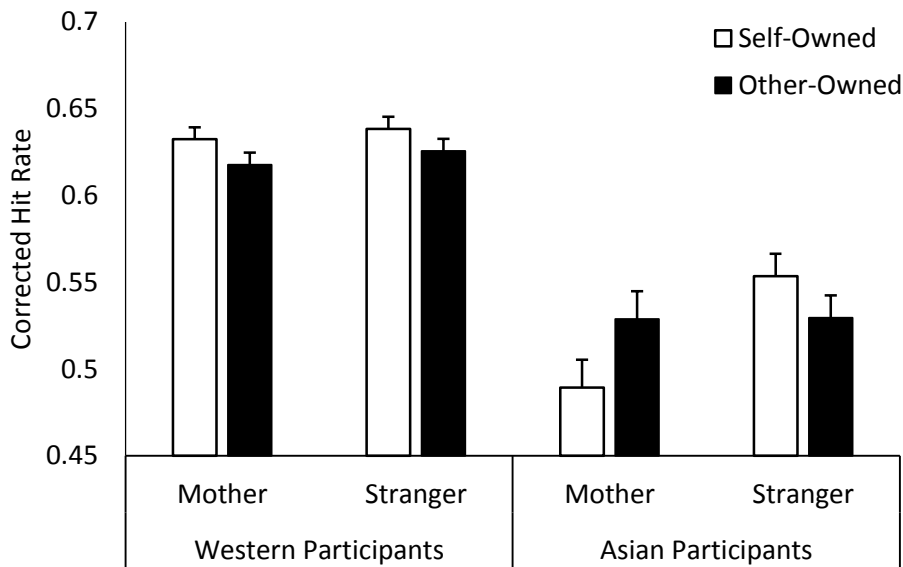


Fig 3. Corrected hit rates for self-owned and other-owned objects as a function of cultural background and other identity. Error bars represent the one standard error of the mean difference for self- versus other-owned items, pooled across other identity for Western participants and within each other identity for Asian participants.

For Western participants, the main effect of ownership was significant, with a higher corrected hit rate for self-owned ($M = 0.64$, $SD = 0.16$) versus other-owned ($M = 0.62$, $SD = 0.16$) objects, $F(1,169) = 4.11$, $p = .044$, $\eta_p^2 = .02$. The other identity main effect ($F(1,169) = 0.08$, $p = .773$) and ownership by other identity interaction ($F(1,169) = 0.02$, $p = .893$) were nonsignificant. Thus across referent conditions, Western participants showed a consistent self-referent ownership effect.

For Asian participants, the main effects of ownership ($F(1,72) = 0.58$, $p = .451$) and other identity ($F(1,72) = 0.90$, $p = .347$) were nonsignificant, but there was a significant ownership by other identity interaction, $F(1,72) = 9.73$, $p = .003$, $\eta_p^2 = .12$. In the mother condition, planned comparisons (Holm-Bonferonni corrected) revealed that corrected hit rate was significantly higher for other-owned ($M = 0.53$, $SD = 0.16$) than self-owned ($M = 0.49$, $SD = 0.15$) objects, $t(33) = 2.50$, $p = 0.036$. In the stranger condition, there was a marginally significant trend in the reverse direction, with a higher corrected hit rate for self-owned ($M = 0.55$, $SD = 0.15$) compared with other-owned ($M = 0.53$, $SD = 0.16$) objects, $t(39) = 1.83$, $p = .075$.

The above analyses suggest Western and Asian participants showed a memory bias of similar magnitude and direction in the stranger condition, but opposite patterns of bias in

1 the mother condition. To compare these memory biases directly, we computed self-bias
2 scores for each participant by subtracting other-owned from self-owned corrected hit rates
3 and multiplying this by 100. In the stranger condition, self-bias scores for Western ($M =$
4 1.28 , $SD = 9.21$) and Asian ($M = 2.40$, $SD = 8.29$) participants did not differ significantly,
5 $t(127) = 0.66$, $p = .512$. In the mother condition, Western participants' positive self-bias
6 scores ($M = 1.46$, $SD = 8.44$) differed significantly from Asians' negative self-bias scores ($M =$
7 -3.94 , $SD = 9.19$), $t(114) = 3.06$, $p = .003$.

8 Finally, we tested whether there was a statistically reliable difference in the pattern of
9 effects between Experiments 1 and 2.¹ We combined participants from the stranger and
10 mother conditions of Experiment 1 with the participants from Experiment 2, and ran a
11 repeated measures ANOVA on corrected hit rate. Experiment, cultural background, and
12 other identity were between-participants factors, and object ownership a within-
13 participants factor. The four-way interaction of experiment by cultural background by other
14 identity by object ownership was significant, $F(1,367) = 7.15$, $p = .008 = \eta_p^2 = .02$. This
15 supports our claim that the new pattern of results that emerged in Experiment 2 can be
16 attributed to the alteration in the object allocation task. In other words, the fact that Asian
17 participants showed a mother-owned advantage in Experiment 2 but not Experiment 1 can
18 be attributed to the modification of the object allocation task (the only way in which these
19 experiments differed).

20 3.3 Discussion

21 Western participants showed the same pattern of results as in Experiment 1, that is,
22 there was a recognition memory advantage for self- over other-owned objects regardless of
23 whether the mother or a stranger was the 'other.'

24 Asian participants again showed a different pattern to Western participants. In
25 contrast to Experiment 1, however, Asian participants in the mother condition showed
26 significantly better memory for *other-owned* (i.e., mother's) objects versus self-owned
27 objects. Additionally, Asian participants trended toward higher recognition performance for
28 self-owned versus other-owned objects in the stranger condition, and this memory bias
29 effect did not significantly differ from Western participants' in magnitude. As in Experiment

¹ We thank an anonymous reviewer for suggesting this analysis.

1 1, Western participants showed higher overall recognition performance than Asian
2 participants.

3 The emergence of this pattern in Experiment 2 suggests that self-construal differences
4 do manifest in processing of self- and other-owned objects, but are to some extent
5 dependent on initial allocation of attentional resources to objects. Given that Asian
6 participants still showed a lower overall recognition rate than Western participants, our
7 modification of the object allocation task may have triggered self- and other-referential
8 processing for Asian participants without being powerful enough to abolish fully cultural
9 differences in attentional allocation to focal objects (Ketay et al., 2009; Kitayama & Uskul,
10 2011; Masuda & Nisbett, 2001, 2006). We return to these points in the General Discussion.

11 **4. General Discussion**

12 Across two experiments we report novel evidence that the ownership status of
13 objects affects memory differently for participants with Western and Asian cultural
14 backgrounds. Western participants in both experiments showed enhanced recognition
15 memory for objects arbitrarily assigned to be the self-owned versus other-owned,
16 regardless of whether the 'other' was a close person (mother, friend) or a stranger. This
17 aligns with an independent self construal which represents the self as distinct from both
18 close others and strangers (Markus & Kitayama, 1991). Asian participants showed no
19 ownership effects in Experiment 1, with no increase in memory for items owned by self over
20 others.

21 Experiment 2, which was designed to encourage greater allocation of attention to the
22 objects than Experiment 1, replicated the finding that a memory advantage for items owned
23 by self only emerged in Western participants. Further, there was evidence that Asian
24 participants prioritised close other referents over the self, as memory for mother-owned
25 objects was superior to self-owned objects. Broadly, these findings for Asian participants are
26 consistent with an interdependent self construal where close others are represented as
27 interconnected with the self (Markus & Kitayama, 2010). Crucially, however, the
28 manifestation of cultural differences in ownership effects is sensitive to task parameters and
29 possibly interacts with cultural differences in attentional strategies. We discuss this point
30 below before considering further how our findings relate to self-construal theory.

31

32

1 *4.1 Top-down Factors Determine Recognition of Items*

2 The critical difference between Experiments 1 and 2 concerned the degree to which
3 participants interacted with objects in the encoding phase. In Experiment 1, each trial
4 consisted of assigning an object to a basket based on a coloured box surrounding the object,
5 and the keypress responses caused no visible change to the object. Although participants
6 were asked to imagine the item going into the basket, it was possible to complete each trial
7 by pressing appropriate key in response to the colour cue without reference to the object
8 itself. Allocation of attention to the object itself would, therefore, depend on the strategy
9 participants applied to the task. In Experiment 2, we encouraged participants to attend to
10 the objects in the encoding phase by requiring them to move the objects across the screen
11 into a bag by holding down a key. This encouraged participants to monitor the object to
12 ensure they moved it fully into the bag, and enhanced the salience of the object by
13 introducing a motion onset. The emergence of a distinct pattern of ownership bias for Asian
14 participants in Experiment 2, but not Experiment 1, suggests that this change in task
15 parameters was effective. Below we consider possible explanations for this.

16 One possibility concerns cultural differences in attentional strategy. Turk et al. (2013)
17 showed that dividing attention during encoding abolished the self-owned advantage in a
18 Western sample. This suggests that the emergence of such effects depends on sufficient
19 allocation of attention to the object at encoding, and aligns with Humphreys and Sui's
20 (2015) proposed Self-Attention Network (SAN). Humphreys and Sui (2015) suggest that self-
21 associated stimuli rapidly activate self-representations housed in the ventral MPFC, which
22 primes the posterior superior temporal sulcus (pSTS) to respond to self-associated stimuli. A
23 top-down attentional control network can enhance or suppress this bottom-up self-
24 referential activation. Crucially, however, Humphreys and Sui (2015) also suggest that
25 bottom-up responses to self-associated stimuli are not always sufficient to produce self-
26 association effects – top-down allocation of attentional resources to the self-associated
27 stimuli may be necessary.

28 From this perspective, the evidence suggesting cultural differences in attention to
29 objects is highly relevant (see Kitayama & Uskul, 2011, for review). Behavioural (Chua et al.,
30 2005; Kitayama, Duffy, Kawamura, & Larsen, 2003; Masuda & Nisbett, 2001, 2006) and
31 neuroimaging (Goh et al., 2007; Gutchess et al., 2006) studies suggest that Western
32 participants tend to prioritise processing individual, focal objects in a scene, whereas Asian

1 participants use a more holistic strategy with greater sensitivity to contextual and
2 background information. Particularly relevant to our results, Gutchess et al. (2006) reported
3 that East Asian participants showed lower recognition accuracy than Western participants
4 for objects presented against a white background when encoding time was brief (2000 ms;
5 Gutchess et al., 2006, footnote 1; see Millar et al., 2013, for similar results). Behavioural
6 performance equalised at longer presentation times (4000 ms), but Western participants
7 nevertheless showed greater neural activity in several areas, including the left middle
8 temporal gyrus, which is important for retrieving semantic knowledge about objects
9 (Gutchess et al., 2006, main experiment). We suggest that in Experiment 1 of our study,
10 Western participants' tendency to allocate resources to processing focal objects enabled a
11 self-owned memory advantage to emerge. In Experiment 1, Asian participants may have
12 allocated fewer resources to processing the objects at encoding, resulting in weaker
13 integration of the object with self- and other-associations introduced by the ownership
14 manipulation. The additional attentional engagement with objects encouraged by the
15 Experiment 2 may have counteracted this default tendency to the extent that a mother-
16 owed bias emerged for Asian participants, although Asian participants' overall recognition
17 accuracy remained lower than Western participants'.

18 An additional possibility is that the objects in the study were more familiar to Western
19 participants compared with Asian participants. We used the same object set as published
20 work showing a self-owned advantage in memory in a computerised implementation of the
21 shopping basket task (Van den Bos et al., 2010), which was itself part of a larger object set
22 that formed the basis of several other studies with this paradigm (Cunningham et al., 2008,
23 2011; Turk et al., 2013). The objects were from Western supermarkets and comprised
24 primarily of food (packaged and unpackaged), household tools and appliances, stationery,
25 furniture, and apparel. English text and/or branding was discernible on 39 of the 150 objects
26 (26%), and it is plausible that the unlabelled foods in the set are more commonly used by
27 people with Western backgrounds. It is, therefore, plausible that Western participants had
28 greater prior familiarity with the objects, which may have resulted in more efficient
29 processing of the objects relative to Asian participants. This might account for Western
30 participants' higher overall recognition performance.

31 Additionally, Western participants' relatively efficient processing may have allowed
32 them to form strong self-associations with self-owned objects in Experiment 1 and display a

1 self-owned advantage in recognition performance. For Asian participants in Experiment 2,
2 the added attentional engagement and longer average presentation time for objects at
3 encoding may have overcome their relative lack of prior familiarity to the extent that a
4 mother-owned advantage arose. If there is a familiarity disadvantage for Asian participants,
5 it would most likely work against this mother-advantage be detectable. We found
6 ambiguous evidence of a self-versus-stranger ownership advantage for Asian participants
7 (see below), and it is possible that removing familiarity differences would allow this
8 advantage to emerge reliably.

9 *4.2 Ownership Effects and Self-Construal*

10 We replicated the memory advantage for self-owned over other-owned objects that
11 has been reported in numerous studies with Western participants (Cunningham et al., 2008,
12 2011; Turk et al., 2013; Van den Bos et al., 2010). This effect aligns with the general
13 prioritisation of self-related over other-related stimuli in perception (Sui, et al., 2012, 2014),
14 attention (Turk, van Bussel, Brebner, et al., 2011), and memory (Symons & Johnson, 1997;
15 Zhu & Zhang, 2002; Zhu et al., 2007) for Western participants. In addition, we found no
16 evidence that this bias was attenuated even when the 'other' was a more self-relevant
17 person, such as the participant's closest friend (Experiment 1) or mother (Experiments 1 &
18 2). This is consistent with Markus and Kitayama's (1991) proposal that in cultures that value
19 an independent self-construal, individuals tend to represent the self as distinct from both
20 close and non-close others.

21 The ownership-related biases shown by Asian participants in Experiment 2 were
22 substantially different from those seen in Western participants. Asian participants who
23 allocated objects to the self and to the mother later recognised other-owned (i.e., mother-
24 owned) objects at a higher rate than self-owned objects, the reverse of the pattern seen for
25 Western participants. This mother-owned memory advantage is consistent with high
26 importance of close others in self-representations in interdependent cultures (Markus &
27 Kitayama, 2010), and with the particular importance of the relationship with the mother
28 during childhood in many Asian cultures (Berndt et al., 1993; Sun & Roopnarine, 1996).

29 The mother-owned recognition advantage for Asian participants in Experiment 2
30 differs from word-based self-referential memory studies, which show comparable
31 performance for self- and mother-associated words (Zhu & Zhang, 2002; Zhu et al., 2007).
32 This novel mother-owned memory *advantage* suggests that in some circumstances close-

1 other-associated stimuli receive the most effective processing, and that the specific context
2 in which self- and other-referential processing occurs can alter the observed effects. In
3 word-based self-referential paradigms with bicultural individuals, culture priming (via
4 culturally-relevant images) can alter the pattern of recognition memory (Sui et al., 2007) and
5 MPFC activity (Ng, Han, Mao, & Lai, 2010) for self, mother, and non-close-other associated
6 stimuli. This shows that the impact of self/other representations on cognition is relatively
7 flexible. In our study, the social context was a 'shopping task' with common food items and
8 other household goods. We speculate that, for Asian participants with interdependent self-
9 construal, this situation may evoke an attentional strategy that reflects deference to the
10 mother's objects and preferences typical of a shopping activity.

11 When the 'other' was a stranger in Experiment 2, Asian participants showed a trend
12 toward a self-owned advantage, and the magnitude of this effect did not differ significantly
13 from Westerners' bias in the stranger condition. A conservative interpretation of this result
14 suggests that the Asian sample shows no self-owned bias in the case of a stranger, but it
15 would be premature to rule out the possibility of a self-owned advantage. Markus and
16 Kitayama (1991; 2010) propose that the ingroup/outgroup distinction is more prominent in
17 interdependent self-construal. Family members (and most close others) are ingroup
18 members, and the interdependent self is represented in terms of the individual's
19 relationship with these important ingroup members. The self is, however, represented as
20 distinct from outgroup members (Markus & Kitayama, 2010). It would be informative,
21 therefore, to manipulate directly the group membership of the stranger in future studies.
22 Possibly, strong self-owned bias will emerge when a stranger is clearly an outgroup
23 member, whereas bias would be reduced for a clearly ingroup stranger.

24 It is important to note that our study may does not address possible within-culture
25 variation in ownership effects. Independent and interdependent self-construal varies
26 considerably for individuals within a given culture, and future studies can investigate the
27 extent to which these differences influence the ownership effects we report in the current
28 study. As Kitayama and Uskul (2011) note, cross-cultural differences in behavioural effects
29 often fail to show expected correlations with individual differences in self-construal,
30 whereas the associated neural indicators more reliably show the predicted relationship.
31 Thus, concurrent neuroimaging would be ideal for such an individual differences study.

32

1 *4.3 Conclusion*

2 We report that ownership elicits cultural differences in self-referential memory
3 effects. The effects, however, depend on the attentional demands of the task. When focal
4 objects are the target stimuli, Asian participants most clearly show self- and other-
5 association effects consistent with interdependent self-construal when top-down attention
6 to the object is encouraged. Western participants show self-bias even when allocation of
7 attention to the object is minimally necessary. Future research can examine the neural
8 indicators of these cultural differences and their relationship to individual differences in self-
9 construal within cultures.

10 **5. Acknowledgements**

11 This project was supported by ARC DP130100253 to AK. We wish to thank Bill von
12 Hippel for his helpful comments on an early version of this manuscript, and the tutors who
13 supervised data collection sessions. We would also like to thank two anonymous reviewers
14 for their very constructive suggestions.

References

- 1
2 Arnett, J. J. (2008). The neglected 95%: Why American psychology needs to become less
3 American. *American Psychologist*, *63*(7), 602-614. doi: 10.1037/0003-066X.63.7.602
- 4 Bayliss, A. P., & Kritikos, A. (2011). Brief report: perceptual load and the autism spectrum in
5 typically developed individuals. *Journal of Autism and Developmental Disorders*,
6 *41*(11), 1573-1578. doi: 10.1007/s10803-010-1159-8
- 7 Beggan, J. K. (1992). On the social nature of nonsocial perception: The mere ownership
8 effect. *Journal of Personality and Social Psychology*, *62*(2), 229-237. doi:
9 10.1037/0022-3514.62.2.229
- 10 Belk, R. W. (1988). Possessions and the extended self. *Journal of Consumer Research*, *15*(2),
11 139-168. doi: 10.2307/2489522
- 12 Belk, R. W. (2014). The extended self unbound. *Journal of Marketing Theory and Practice*,
13 *22*(2), 133-134.
- 14 Berndt, T. J., Cheung, P. C., Lau, S., Hau, K.-T., & Lew, W. J. F. (1993). Perceptions of
15 parenting in mainland China, Taiwan, and Hong Kong: Sex differences and societal
16 differences. *Developmental Psychology*, *29*(1), 156-164. doi: 10.1037/0012-
17 1649.29.1.156
- 18 Boduroglu, A., Shah, P., & Nisbett, R. E. (2009). Cultural differences in allocation of attention
19 in visual information processing. *Journal of Cross-Cultural Psychology*, *40*(3), 349-360.
20 doi: 10.1177/0022022108331005
- 21 Bower, G. H., & Gilligan, S. G. (1979). Remembering information related to one's self.
22 *Journal of Research in Personality*, *13*(4), 420-432. doi:
23 [http://dx.doi.org/10.1016/0092-6566\(79\)90005-9](http://dx.doi.org/10.1016/0092-6566(79)90005-9)
- 24 Caudek, C. (2014). Individual differences in cognitive control on self-referenced and other-
25 referenced memory. *Consciousness and Cognition*, *30*, 169-183. doi:
26 <http://dx.doi.org/10.1016/j.concog.2014.08.017>
- 27 Chiao, J. Y., Harada, T., Komeda, H., Li, Z., Mano, Y., Saito, D., . . . Iidaka, T. (2009). Neural
28 basis of individualistic and collectivistic views of self. *Human Brain Mapping*, *30*(9),
29 2813-2820. doi: 10.1002/hbm.20707
- 30 Chua, H. F., Boland, J. E., & Nisbett, R. E. (2005). Cultural variation in eye movements during
31 scene perception. *Proceedings of the National Academy of Sciences*, *102*(35), 12629-
32 12633. doi: 10.1073/pnas.0506162102

- 1 Constable, M. D., Kritikos, A., & Bayliss, A. P. (2011). Grasping the concept of personal
2 property. *Cognition*, *119*(3), 430-437. doi: 10.1016/j.cognition.2011.02.007
- 3 Constable, M. D., Kritikos, A., Lipp, O. V., & Bayliss, A. P. (2014). Object ownership and
4 action: the influence of social context and choice on the physical manipulation of
5 personal property. *Experimental Brain Research*, *232*(12), 3749-3761. doi:
6 10.1007/s00221-014-4063-1
- 7 Cunningham, S. J., Brady-Van den Bos, M., & Turk, D. J. (2011). Exploring the effects of
8 ownership and choice on self-memory biases. *Memory*, *19*(5), 449-461.
9 doi:10.1080/09658211.2011.584388
- 10 Cunningham, S. J., Turk, D. J., Macdonald, L. M., & Macrae, N. C. (2008). Yours or mine?
11 Ownership and memory. *Consciousness and Cognition*, *17*(1), 312-318.
- 12 Feng, T., Zhao, W., & Donnay, G. F. (2013). The endowment effect can extend from self to
13 mother: evidence from an fMRI study. *Behavioural Brain Research*, *248*, 74-79.
14 doi:10.1016/j.bbr.2013.04.005
- 15 Goh, J. O., Chee, M. I., Tan, J. C., Venkatraman, V., Hebrank, A., Leshikar, E. D., . . . Park, D. C.
16 (2007). Age and culture modulate object processing and object—scene binding in the
17 ventral visual area. *Cognitive, Affective, & Behavioral Neuroscience*, *7*(1), 44-52. doi:
18 10.3758/CABN.7.1.44
- 19 Gutchess, A. H., Welsh, R. C., Boduroğlu, A., & Park, D. C. (2006). Cultural differences in
20 neural function associated with object processing. *Cognitive, Affective, & Behavioral*
21 *Neuroscience*, *6*(2), 102-109. doi: 10.3758/CABN.6.2.102
- 22 Han, S., & Northoff, G. (2008). Culture-sensitive neural substrates of human cognition: a
23 transcultural neuroimaging approach. *Nature Reviews: Neuroscience*, *9*(8), 646-654.
- 24 Han, S., Northoff, G., Vogeley, K., Wexler, B. E., Kitayama, S., & Varnum, M. E. W. (2013). A
25 Cultural neuroscience approach to the biosocial nature of the human brain. *Annual*
26 *Review of Psychology*, *64*(1), 335-359. doi: 10.1146/annurev-psych-071112-054629
- 27 He, X., Sebanz, N., Sui, J., & Humphreys, G. W. (2014). Individualism-collectivism and
28 interpersonal memory guidance of attention. *Journal of Experimental Social*
29 *Psychology*, *54*, 102-114. doi: DOI 10.1016/j.jesp.2014.04.010
- 30 Heine, S. J., & Ruby, M. B. (2010). Cultural psychology. *Wiley Interdisciplinary Reviews:*
31 *Cognitive Science*, *1*(2), 254-266. doi: 10.1002/wcs.7

- 1 Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world?
2 *Behavioral and Brain Sciences*, 33(2-3), 61-83. doi: doi:10.1017/S0140525X0999152X
- 3 Huff, S., Ligouri, L., & Gutchess, A. (2015). Cultural Influences on Social and Self-Relevant
4 Memory. In J. E. Warnick & D. Landis (Eds.), *Neuroscience in Intercultural Contexts* (pp.
5 215-241): Springer New York.
- 6 Huff, S., Yoon, C., Lee, F., Mandadi, A., & Gutchess, A. H. (2013). Self-referential processing
7 and encoding in bicultural individuals. *Culture and Brain*, 1(1), 16-33. doi:
8 10.1007/s40167-013-0005-1
- 9 Humphreys, G. W., & Sui, J. (2015). Attentional control and the self: The Self-Attention
10 Network (SAN). *Cognitive Neuroscience*. doi: 10.1080/17588928.2015.1044427
- 11 Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: the endowment effect, loss
12 aversion, and status quo bias. *The Journal of Economic Perspectives*, 5(1), 193-206.
13 doi: 10.2307/1942711
- 14 Kelley, W. M., Macrae, C. N., Wyland, C. L., Caglar, S., Inati, S., & Heatherton, T. F. (2002).
15 Finding the self? An event-related fMRI study. *Journal of Cognitive Neuroscience*,
16 14(5), 785-794. doi: 10.1162/08989290260138672
- 17 Ketay, S., Aron, A., & Hedden, T. (2009). Culture and attention: Evidence from brain and
18 behavior. In Y. C. Joan (Ed.), *Progress in Brain Research* (Vol. Volume 178, pp. 79-92):
19 Elsevier.
- 20 Kim, K., & Johnson, M. K. (2012). Extended self: Medial prefrontal activity during transient
21 association of self and objects. *Social Cognitive and Affective Neuroscience*, 7(2), 199-
22 207. doi: 10.1093/scan/nsq096
- 23 Kim, K., & Johnson, M. K. (2014). Extended Self: spontaneous activation of medial prefrontal
24 cortex by objects that are 'mine'. *Social Cognitive and Affective Neuroscience*, 9(7),
25 1006-1012. doi: 10.1093/scan/nst082
- 26 Kim, K., & Johnson, M. K. (2015). Activity in ventromedial prefrontal cortex during self-
27 related processing: positive subjective value or personal significance? *Social Cognitive*
28 *and Affective Neuroscience*, 10(4), 494-500. doi: 10.1093/scan/nsu078
- 29 Kitayama, S., Duffy, S., Kawamura, T., & Larsen, J. T. (2003). perceiving an object and its
30 context in different cultures: A cultural look at new look. *Psychological Science*, 14(3),
31 201-206. doi: 10.1111/1467-9280.02432

- 1 Kitayama, S., Markus, H. R., Matsumoto, H., & Norasakkunkit, V. (1997). Individual and
2 collective processes in the construction of the self: Self-enhancement in the United
3 States and self-criticism in Japan. *Journal of Personality and Social Psychology*, *72*(6),
4 1245-1267. doi: 10.1037/0022-3514.72.6.1245
- 5 Kitayama, S., & Uskul, A. K. (2011). Culture, mind, and the brain: Current evidence and
6 future directions. *Annual Review of Psychology*, *62*(1), 419-449. doi: 10.1146/annurev-
7 psych-120709-145357
- 8 Klein, S. B. (2012). Self, Memory, and the Self-Reference Effect: An Examination of
9 Conceptual and Methodological Issues. *Personality and Social Psychology Review*,
10 *16*(3), 283-300. doi:10.1177/1088868311434214
- 11 Kuiper, N. A., & Rogers, T. B. (1979). Encoding of personal information: Self–other
12 differences. *Journal of Personality and Social Psychology*, *37*(4), 499-514. doi:
13 10.1037/0022-3514.37.4.499
- 14 Maddux, W. W., Yang, H., Falk, C., Adam, H., Adair, W., Endo, Y., . . . Heine, S. J. (2010). For
15 whom is parting with possessions more painful? Cultural differences in the
16 endowment effect. *Psychological Science*, *21*(12), 1910-1917. doi:
17 10.1177/0956797610388818
- 18 Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition,
19 emotion, and motivation. *Psychological Review*, *98*(2), 224-253. doi: 10.1037/0033-
20 295X.98.2.224
- 21 Markus, H. R., & Kitayama, S. (2010). Cultures and selves: A cycle of mutual constitution.
22 *Perspectives on Psychological Science*, *5*(4), 420-430. doi: 10.1177/1745691610375557
- 23 Masuda, T., & Nisbett, R. E. (2001). Attending holistically versus analytically: Comparing the
24 context sensitivity of Japanese and Americans. *Journal of Personality and Social
25 Psychology*, *81*(5), 922-934. doi: 10.1037/0022-3514.81.5.922
- 26 Masuda, T., & Nisbett, R. E. (2006). Culture and change blindness. *Cognitive Science*, *30*(2),
27 381-399. doi: 10.1207/s15516709cog0000_63
- 28 McKone, E., Aimola Davies, A., Fernando, D., Aalders, R., Leung, H., Wickramariyaratne, T., &
29 Platow, M. J. (2010). Asia has the global advantage: Race and visual attention. *Vision
30 Research*, *50*(16), 1540-1549. doi: <http://dx.doi.org/10.1016/j.visres.2010.05.010>
- 31 Millar, P. R., Serbun, S. J., Vadalía, A., & Gutchess, A. H. (2013). Cross-cultural differences in
32 memory specificity. *Culture and Brain*, *1*(2-4), 138-157. doi:10.1007/s40167-013-0011-

- 1 Morewedge, C. K., & Gliblin, C. E. (2015). Explanations of the endowment effect: An
2 integrative review. *Trends in Cognitive Science*, *19*(6), 339-348. doi:
3 10.1016/j.tics.2015.04.004
- 4 Ng, S. H., Han, S., Mao, L., & Lai, J. C. L. (2010). Dynamic bicultural brains: fMRI study of their
5 flexible neural representation of self and significant others in response to culture
6 primes. *Asian Journal of Social Psychology*, *13*(2), 83-91. doi: 10.1111/j.1467-
7 839X.2010.01303.x
- 8 Norasakkunkit, V., & Kalick, S. M. (2002). Culture, ethnicity, and emotional distress
9 measures: The role of self-construal and self-enhancement. *Journal of Cross-Cultural*
10 *Psychology*, *33*(1), 56-70. doi: 10.1177/0022022102033001004
- 11 Northoff, G., Heinzl, A., de Greck, M., Bermpohl, F., Dobrowolny, H., & Panksepp, J. (2006).
12 Self-referential processing in our brain—A meta-analysis of imaging studies on the
13 self. *Neuroimage*, *31*(1), 440-457. doi:
14 <http://dx.doi.org/10.1016/j.neuroimage.2005.12.002>
- 15 Sui, J., He, X., & Humphreys, G. W. (2012). Perceptual effects of social salience: evidence
16 from self-prioritization effects on perceptual matching. *Journal of Experimental*
17 *Psychology: Human Perception and Performance*, *38*(5), 1105-1117. doi:
18 10.1037/a0029792
- 19 Sui, J., Sun, Y., Peng, K., & Humphreys, G. W. (2014). The automatic and the expected self:
20 separating self- and familiarity biases effects by manipulating stimulus probability.
21 *Attention, Perception, & Psychophysics*, *76*(4), 1176-1184. doi: 10.3758/s13414-014-
22 0631-5
- 23 Sui, J., Zhu, Y., & Chiu, C.-y. (2007). Bicultural mind, self-construal, and self- and mother-
24 reference effects: Consequences of cultural priming on recognition memory. *Journal*
25 *of Experimental Social Psychology*, *43*(5), 818-824. doi: 10.1016/j.jesp.2006.08.005
- 26 Sun, L.-C., & Roopnarine, J. L. (1996). Mother-infant, father-infant interaction and
27 involvement in childcare and household labor among Taiwanese families. *Infant*
28 *Behavior and Development*, *19*(1), 121-129. doi: <http://dx.doi.org/10.1016/S0163->
29 6383(96)90050-8
- 30 Symons, C. S., & Johnson, B. T. (1997). The self-reference effect in memory: A meta-analysis.
31 *Psychological Bulletin*, *121*(3), 371-394. doi: 10.1037/0033-2909.121.3.371

- 1 Thaler, R. (1980). Toward a positive theory of consumer choice. *Journal of Economic*
2 *Behavior & Organization*, 1(1), 39-60. doi: <http://dx.doi.org/10.1016/0167->
3 2681(80)90051-7
- 4 Turk, D. J., Brady-van den Bos, M., Collard, P., Gillespie-Smith, K., Conway, M. A., &
5 Cunningham, S. J. (2013). Divided attention selectively impairs memory for self-
6 relevant information. *Memory and Cognition*, 41(4), 503-510. doi:10.3758/s13421-
7 012-0279-0
- 8 Turk, D. J., van Bussel, K., Brebner, J. L., Toma, A. S., Krigolson, O., & Handy, T. C. (2011).
9 When "it" becomes "mine": attentional biases triggered by object ownership. *Journal*
10 *of Cognitive Neuroscience*, 23(12), 3725-3733. doi: 10.1162/jocn_a_00101
- 11 Turk, D. J., van Bussel, K., Waiter, G. D., & Macrae, C. N. (2011). Mine and Me: Exploring the
12 Neural Basis of Object Ownership. *Journal of Cognitive Neuroscience*, 23(11), 3657-
13 3668.
- 14 van den Bos, M., Cunningham, S. J., Conway, M. A., & Turk, D. J. (2010). Mine to remember:
15 The impact of ownership on recollective experience. *Quarterly Journal of Experimental*
16 *Psychology*, 63(6), 1065-1071.
- 17 Wang, G., Mao, L., Ma, Y., Yang, X., Cao, J., Liu, X., . . . Han, S. (2012). Neural representations
18 of close others in collectivistic brains. *Social Cognitive and Affective Neuroscience*,
19 7(2), 222-229. doi: 10.1093/scan/nsr002
- 20 Zhao, W., Feng, T., & Kazinka, R. (2014). The extensibility of the endowment effect to others
21 is mediated by degree of intimacy. *Asian Journal of Social Psychology*, 17(4), 296-301.
22 doi:10.1111/ajsp.12061
- 23 Zhu, Y., & Zhang, L. (2002). An experimental study on the self-reference effect. *Science in*
24 *China Series C: Life Sciences*, 45(2), 120-128. doi: 10.1360/02yc9014
- 25 Zhu, Y., Zhang, L., Fan, J., & Han, S. (2007). Neural basis of cultural influence on self-
26 representation. *Neuroimage*, 34(3), 1310-1316. doi:
27 <http://dx.doi.org/10.1016/j.neuroimage.2006.08.047>
28