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Sex Differences in Semantic Categorization

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ABSTRACT

Sex differences in certain cognitive abilities, including aspects of semantic processing, are well established. However, there have been no reports investigating a sex difference in semantic categorization. A total of 55 men and 58 women each judged 25 exemplars of natural categories (e.g., FRUITS) and 25 of artifact categories (e.g., TOOLS) as a nonmember, partial member, or full member of the given category. Participants also rated confidence for each judgment. Women provided a greater number vague (partial member) judgments, whereas men provided more inclusive (full member) judgments of artifacts but more exclusive (nonmember) judgments of natural categories. The sex difference in vagueness was observed across domains (Cohen's d = .56). Confidence predicted categorization among both men and women, such that more confident participants exhibited fewer vague category judgments. However, men and women were equally confident in their category judgments, and confidence failed to explain the sex difference in categorization. Men and women appear to categorize the same common objects in systematically different ways.

KEYWORDS: artifacts and natural kinds; confidence; semantic categorization; sex differences.

INTRODUCTION

Sex differences in certain aspects of cognition have been established across domains and cultures (Kimura, 2002). Men and women display, on average, different patterns of task performance in domains such as spatial orientation and verbal or perceptual skills (Kimura, 2002). For instance, men tend to excel on tasks of spatial ability such as mental rotation (Linn & Petersen, 1985; Voyer, Voyer, & Bryden, 1995), whereas women tend to excel on tasks of linguistic ability such as verbal fluency (Kolb & Wishaw, 1985; Spreen & Strauss, 1991; for review, see Hines, 2009). Although there is substantial overlap between male and female performance and cognitive abilities may be better characterized by between-sex similarities rather than differences (Hyde, 2005), studying sex differences in cognition is important as it may elucidate mechanisms underlying sex-differentiated behavior, which, in turn, may inform our understanding of sex stereotypes (Hyde, 2007).

One aspect of cognition that has not been investigated in terms of a sex difference, but could have broad implications, is semantic categorization. Indeed, several studies indicate a sex difference in processing natural categories (categories occurring independently of human production or intention, such as FRUITS) as well as artifact categories (categories occurring by human production or intention, such as TOOLS). Whereas women name natural objects faster and more fluently, men name artifacts faster and more fluently (Capitani, Laiacona, & Barbarotto, 1999; Laws, 1999). Women also recognize natural objects more accurately, whereas men recognize artifacts more accurately (Barbarotto, Laiacona, Macchi, & Capitani, 2002). Similar effects have also been observed in semantic priming, where natural category names facilitate subsequent judgments of their exemplars (e.g., FISH → trout) more strongly for women than for men, but artifact category names facilitate judgments (e.g., TOOL → hammer) more strongly for men than for women (Bermeitinger, Wentura, & Frings, 2008). Given this sex difference

in semantic processing, we hypothesized that categorization would also exhibit a sex difference.

A further finding with respect to natural and artifact categories is that they differ in terms of *vagueness*, i.e., whether membership in the given category is absolute (all-or-none) or graded (a matter of degree; see Hampton, 2007). Artifact categories tend to be judged with more vagueness than natural categories (Diesendruck & Gelman, 1999; Estes, 2003; Hampton, 1998; Rhodes & Gelman, 2009). For example, a computer may partially belong in the category TOOLS, but a tomato tends to be judged either completely in or completely out of the category FRUITS. So given the sex difference in processing artifacts and natural objects, and given that artifacts and natural objects differ in vagueness, we tested whether men and women differ in the vagueness of their category judgments.

In the present study, participants judged whether each of 50 items (e.g., tomato–FRUITS, computer–TOOLS) is a full member, partial member, or nonmember of its target category, and they were informed that "Partial membership means that the item does belong in the category, but not to the same extent as some other items." The percentage of partial membership judgments is a measure of category *vagueness* (Estes, 2003), whereas the percentages of full member and nonmember judgments respectively are measures of category *inclusivity* and *exclusivity*. Because vague category judgments are associated with less confidence (Estes, 2004), we also tested whether confidence was related to the predicted sex difference in vagueness.

METHOD

Participants

A total of 113 students and staff at the University of Warwick participated for £3 each. The mean age was 21.9 years for men (N = 55, SD = 3.4) and 24.1 years for women

(N = 58, SD = 8.3). This difference in age was nonsignificant ($p > .05$). To check the sample's representativeness of men and women, participants' sex-typedness was assessed via a retrospective version of the Pre-school Activities Inventory (*PSAI*; Golombok & Rust, 1993). The PSAI is a robust 17-item measure of self-reported masculinity and femininity. As expected, men (M = 69, SD = 9.55) were significantly more masculine than women (M = 40, SD = 15.13), $t(111) = 12.08$, $p < .001$). In this case, we can assume typicality for sex-typedness in the current sample.

Measures

Twenty-five target items from seven artifact categories and 25 target items from six natural categories were sampled from Estes (2003). These target items were sampled on the basis of prior studies in which the selected items were the most likely to elicit disagreement between participants and uncertainty within participants. Thus, all targets were "borderline items" for which category membership is unclear and which were most likely to elicit vague judgments (Hampton, 2007). Stimuli are shown in the Appendix. Note that because most of these categories lack a clear and consensual definition, participants' judgments about these categories are subjective and hence are not classifiable as "correct" or "incorrect." For example, because FISH is not a biologically defined category, judging an item to belong or not belong in the category is subjective.

Procedure

The items and their target categories were presented in random order, and participants judged each item as a nonmember, partial member, or full member of the given category. Instructions were based on those used by Estes (2003). Using the example billiards:SPORTS, the instructions read: "If you believe that billiards is not a sport, then you should check the nonmember box. Or if you think that billiards is only somewhat a member of the category, then you should check the partial member box. But if you

believe that it's just as much a member of the category as any other sport, then you should indicate that it's completely a member by checking the full member box…Partial membership means that the item does belong in the category, but not to the same extent as some other items." After each category judgment, participants also rated their confidence in that judgment on a scale ranging from 1 = "not at all confident" to 5 = "completely confident."

RESULTS

Confidence

We first examined whether participants' confidence (i.e., mean confidence ratings) predicted the vagueness of their category judgments (i.e., percentage of "partial member" judgments). Indeed, more confident participants produced fewer vague category judgments (r = -.33, p < .001), and this correlation was observed among both men (r = -.27, p < .05) and women (r = -.41, p < .01). This significant negative relationship between confidence and vagueness corroborates prior research (Estes, 2004). It also indicates that any sex difference observed in vagueness might be due to a concomitant sex difference in confidence. To test for such a sex difference, participants' mean confidence ratings were analyzed via a 2 (sex) × 2 (domain) ANOVA. Only the expected main effect of domain was significant, $F(1, 111) = 11.15$, p < .001; artifact categories (M = 4.07, SE = .05) were judged with greater confidence than natural categories (M = 3.95, SE = .05; see also Estes, 2004). For instance, participants were more confident in their judgments of whether a computer is a TOOL than of whether a tomato is a FRUIT. More importantly, men and women were equally confident in their judgments (M = 4.01, SD = .52, F < 1). Thus, if there were a sex difference in categorization, it would not be attributable to a sex difference in confidence.

Categorization

Mean percentages of exclusive ("nonmember"), vague ("partial member"), and inclusive ("full member") category judgments are summarized in Table 1 (including effect sizes in *d*; Cohen, 1988). Participants' mean percentages of vague category judgments were analyzed via a 2 (sex) × 2 (domain) ANOVA. In corroboration of prior research (e.g., Estes, 2003), artifact categories were judged with more vagueness than natural categories, $F(1, 111) = 118.01$, $p < .001$. For example, participants were more likely to judge that a computer is a partial member of the TOOL category than to judge that a tomato is a partial member of the FRUIT category. More importantly, however, sex also predicted vagueness, $F(1, 111) = 8.89$, $p < .01$. Women provided more vague category judgments than men across domains, i.e., sex and domain did not interact ($p = .66$). The effect size of this sex difference in vagueness was medium ($d = .56$; see Table 1 for effect sizes within each domain). To be conservative, we also analyzed these data with participants' mean confidence ratings included as a covariate (ANCOVA). With confidence statistically controlled, the sex difference in vagueness remained significant, $F(1, 110) = 10.01$, $p < .01$. Thus again, the sex difference in vagueness was not attributable to confidence.

Having observed a robust sex difference in vagueness, we next examined whether it was complemented by a sex difference in exclusivity, inclusivity, or both. That is, given that men exhibited fewer "partial member" judgments, did they exhibit more "nonmember" judgments or more "full member" judgments than women? Participants' mean percentages of exclusive (nonmember) and inclusive (full member) judgments were analyzed via a 2 (sex) × 2 (domain) MANOVA. Sex and domain interacted significantly in exclusive judgments, $F(1, 111) = 4.75$, $p < .05$, and marginally in inclusive judgments, $F(1, 111) = 3.28$, $p = .07$. As evident in Table 1, men exhibited significantly more inclusive judgments of artifacts, $t(111) = 2.36$, $p < .05$, but significantly more exclusive

judgments of natural categories, $t(111) = 2.29$, $p < .05$. For instance, men were more likely than women to judge that a computer is a full member of the TOOL category, and that a tomato is not at all a FRUIT. These sex differences were also medium, with effect sizes of .44 and .43 in the artifact and natural categories respectively.

Finally, we also tested the generality of these results across items rather than participants. Mean percentages of exclusive, vague, and inclusive judgments were analyzed via a 2 (sex) × 2 (domain) MANCOVA, with confidence included as a covariate. The pattern of results replicated that described above: Vague judgments exhibited significant main effects of sex, $F(1, 47) = 5.78$, $p < .05$, and domain, $F(1, 47) = 150.16$, $p < .001$, without interaction ($p = .84$), whereas significant interactions were observed in both exclusive judgments, $F(1, 47) = 8.35$, $p < .01$, and inclusive judgments, $F(1, 47) = 8.47$, $p < .01$.

DISCUSSION

This study yielded three novel findings. First, these results revealed a domain-general sex difference in vagueness ($d = .56$). Women provided more vague judgments than men in both artifact and natural categories. Although prior studies have demonstrated sex differences in naming (Capitani et al., 1999; Laws, 1999), recognition (Barbarotto et al., 2002), and semantic priming (Bermeitinger et al., 2008) of artifact and natural objects, the present study provided the first demonstration of a sex difference in the categorization of such objects. So whereas prior studies have revealed differences in the speed and/or accuracy of participants' responses, the present study showed a sex difference in actual judgments. Men and women categorized the same common objects in systematically different ways.

Second, we also found a domain-specific sex difference in absolute judgments. Relative to women, men provided more inclusive judgments of artifacts and more

exclusive judgments of natural categories. This finding is broadly consistent with the prior demonstrations of a sex difference in semantic processing, with men and women exhibiting superior processing of artifacts and natural objects respectively (Barbarotto et al., 2002; Capitani et al., 1999; Laws, 1999). For example, in the semantic fluency task administered by Capitani et al. (1999), men produced more instances of the category TOOLS, whereas women produced more instances of FRUITS. Men's superior fluency with artifact categories may, in fact, be related to the greater inclusivity of their artifact categories. That is, if men have more inclusive artifact categories than women, it follows that they would have more instances upon which to draw in the semantic fluency task. And, conversely, the greater exclusivity of men's natural categories might also be related to their inferior fluency in naming natural objects.

A third novel finding of this study was that participants' confidence predicted their categorization, but confidence failed to explain the observed sex differences in categorization. Confidence negatively predicted vagueness among both men and women, such that more confident participants provided fewer vague category judgments (cf. Estes, 2004). However, men and women were equally confident in their category judgments, and statistically controlling participants' confidence failed to eliminate the sex difference in vagueness. Thus, the sex difference in categorization was not attributable to a sex difference in confidence.

Rather than indicating a sex difference in semantic categorization per se, this result could instead reflect a general tendency for women to choose more moderate responses than men. That is, women might simply be more likely to select a middling or mid-scale response, whereas men might be more likely to select an extreme or endpoint response, regardless of the task. If so, then the aforementioned sex difference would say little about categorization in particular. We used participants' confidence ratings to test

this potential explanation. We calculated for each participant the percentage of confidence ratings that were moderate, operationally defined as any response of 2, 3, or 4 on the 1-to-5 confidence scale. Contrary to the moderation hypothesis, women were no more likely than men to select moderate confidence ratings ($t < 1$). Thus, the sex difference in category judgment appears to be a genuine sex difference in semantic categorization rather than a sex difference in scale use.

The sex difference in categorization is also consistent with a sex difference in the use of tentative language. In general, women tend to use more tentative language such as hedges (e.g., "sort of") and disclaimers (e.g., "I'm not sure"; Carli, 1990). This tendency is particularly evident when discussing masculine topics such as sports; when discussing feminine topics such as fashion, however, men use more tentative language than women (Palomares, 2009). This sex difference in tentative language may reflect the sex differences in exclusive and inclusive judgments demonstrated here.

The present study also replicated a domain difference in categorization (Diesendruck & Gelman, 1999; Estes, 2003; Hampton, 1998, 2007; Rhodes & Gelman, 2009), such that artifact categories were judged with greater vagueness than natural categories. This effect is typically attributed to a domain difference in category representation. Whereas artifact categories are primarily represented according to their functions, which are mutable, natural categories tend to be represented according to their appearance and biological features, which are less mutable (e.g., Hampton, Storms, Simmons, & Heussen, 2009). More importantly for our purposes, this replication supports the validity of our sample.

This sex difference in categorization could have important social implications in career choices and performance. The differential tendency for absolute judgments may partially explain the gender gap in fields that allow more or less precision or vagueness,

such as sciences and humanities. Furthermore, categorization may also affect performance within one's chosen profession. For instance, male doctors may be more or less likely than female doctors to diagnose a given set of symptoms as a disease. The potential consequences are manifold, and further studies may be fruitful.

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Appendix. Stimuli.

Domain			
Artifactual		**Natural**	
Category	**Exemplar**	**Category**	**Exemplar**
Clothing	headband	Animals	bacterium
	pocket		fungus
Furniture	clock		virus
	piano		yeast
	refrigerator	Fish	clam
	shelves		crab
Ships	canoe		lobster
	kayak		octopus
	raft		plankton
	spacecraft		seahorse
Tools	computer		shrimp
	funnel		squid
	paint	Fruits	avocado
Toys	backgammon		coconut
	cards		cucumber
	guitar		rhubarb
	string		tomato
Vehicles	horse	Insects	caterpillar
	roller skates		leech
	tricycle		scorpion
	wheelchair		spider
Weapons	car		worm
	chair	Mammals	goose
	drugs	Vegetables	pumpkin
	fingernails		rice

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Table 1. Percentages of exclusive (nonmember), vague (partial member), and inclusive (full member) category judgments of artifact and natural categories by men (N = 55) and women (N = 58).

		Men		Women			
Domain	Judgment	*M*	*SE*	*M*	*SE*	*p*	*d*
Artifactual	Exclusive	20.15	2.10	20.55	1.96	.89	.03
	Vague	45.82	2.75	52.76	2.19	.05	.37
	Inclusive	34.04	2.42	26.69	1.99	.02	.44
Natural	Exclusive	44.07	2.78	35.10	2.76	.02	.43
	Vague	21.45	2.29	30.28	2.39	.01	.50
	Inclusive	34.47	2.29	34.62	2.45	.97	.00

Note. d = Cohen's d (Cohen, 1988).