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GENDER PICTURE PRIMING: IT WORKS WITH DENOTATIVE AND CONNOTATIVE PRIMES

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When physical objects or words are encountered, to what extent is their primary semantic meaning also accompanied by secondary social category associates of semantic meaning? Does such an effect occur without conscious control over the activation of secondary meaning as is true of primary meaning? Automatic priming of the social categories "female" and "male" was demonstrated in two experiments using picture and word stimuli as primes and targets. Experiment 1 used a mixed–modality priming design to provide a stringent test of priming. Primes were words consistent with gender–stereotypic roles (e.g., mechanic, hairdresser) or words containing gender–specific suffixes (e.g., congressman, congresswomen). Targets were pictures of male and female faces that communicated gender as primary meaning. Even though modalities were mixed, gender priming effects were obtained, with stronger effects with female than male primes. Having established the presence of gender priming with items that denote gender primarily (male/female faces), Experiment 2 included a broader set of pictures, using them both as primes and targets to explore the critical hypothesis that even when gender is not the primary meaning communicated

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by the picture, that mere association to gender leads to systematic and automatic activation of "maleness" or "femaleness." Although, as expected, the strongest priming effects were observed with pictures that unambiguously denoted gender, the effect was also present for pictures that merely connoted gender through association (e.g., oven mitt vs. baseball mitt). The results are interpreted as evidence for the importance of social category knowledge in knowing and understanding.

When we come upon a person, many features of the target are rapidly encoded—size and shape, facial features and expression, clothing, and more. These features and the inferences drawn from them, allow, even require, perceivers to make quick assessments about the physical, psychological, and social status of the person. Among the most basic of such "person" features that are automatically communicated is a person's gender, which we expect is highly correlated with biological sex—visual images of men and women can readily activate masculinity and femininity in the mind of the perceiver. A substantial body of research now supports the notion that knowledge about the attributes associated with social categories such as gender can influence judgments about and behaviors toward members of social groups (e.g., Banaji, Lemm, & Carpenter, 2001; Bargh, 1997; Brewer, 1988; Fiske, 1998).

But can knowledge of social groups be activated by objects that do not themselves primarily communicate such information? For example, can the picture of a "mitt" differentially activate male and female if it is an oven mitt versus a catcher's mitt? What about objects such as a furry kitten versus a growling dog? If an oven mitt or a kitten activates femininity, it cannot be because the objects themselves are female—an oven mitt does not possess a gender, and a kitten is just as likely to be male as female. If objects such as these do activate gender, and it is not known that they do, it must be due to a secondary association of the object with a particular gender group. For example, it may be that the item is used or owned more so by one group or another (baseball mitts are more likely to be worn by boys and men than girls and women, the opposite for oven mitts) or because these objects possess secondary features that are associated with femininity or masculin-

ity (e.g., a straight–backed chair vs. a curved–backed chair). Because of the ubiquity of gender as a social category in all human societies, we select it as the location to test the possibility that some categories may be fundamental enough that objects that do not directly refer to them can nevertheless communicate information about them, and do so automatically. Such an analysis has the ability to speak to the importance of social categories in perception and meaning–making, and it also can shed light on the nature of semantic priming by showing the multiple levels of meaning that can be derived almost instantaneously upon encountering a word or picture.

Automatic stereotypes of social groups have been demonstrated using a variety of measures. In particular, observing the speed to respond to a target in the presence or absence of a gender–consistent prime—gender priming—has yielded clear results. For example, Blair and Banaji (1996) presented participants with trait or nontrait word primes (e.g., gentle or ballet) that were immediately followed by a male or female target name (e.g., Adam or Alice). The result that target names were identified as male or female faster when preceded by gender–congruent primes (than by gender–incongruent primes) was taken as an indication of the automaticity of gender use in social cognition. Consistent with Neely's (1977, 1991) recommendation that priming effects with short stimulus–onset–asynchronies (SOAs) can reasonably be considered to be tapping automatic processing, Blair and Banaji supported the automaticity of gender priming effects by showing that participants using a conscious counter–stereotype strategy could not eliminate the priming effect with a short (350 ms) SOA, but could do so easily with a very long (2,000 ms) SOA.

Other studies have shown similar priming effects with a variety of verbal stimuli. For example, Macrae, Mitchell, and Pendry (2002) reversed the prime and target categories and showed that male and female first names primed judgments of masculine- and feminine-stereotyped words. They further demonstrated that the strength of gender priming effects is moderated by the familiarity of the prime stimuli, with more familiar names producing stronger priming effects. Banaji and Hardin (1996) observed greater facilitation of category judgments of gender–specific pronouns

when preceded by gender–consistent prime words (e.g., *mechanic–he*) relative to gender–inconsistent primes (e.g., *secretary–he*). They further showed that this effect holds even when the judgment task is unrelated to gender (e.g., pronoun vs. not a pronoun). Gurjanov, Lukatela, Lukatela, Savic, and Turvey (1985) observed similar priming from gender–specific possessive adjectives to gender–congruent nouns in the Serbo–Croatian language. Significant gender priming effects were observed for words that communicate gender strongly through grammatical inflection (i.e., masculine vs. feminine word endings) as well as those for which the grammatical inflection advantage is absent.

Kawakami and Dovidio (2001) tested gender priming effects across stimulus modalities by using stereotype–consistent trait words as primes and photographs of male and female college students as targets. Replicating previous research with verbal primes and targets, they demonstrated that gender stereotype words primed judgments of male and female faces. In addition they showed that gender stereotype priming has reasonable test–retest reliability. The common thread that unifies these investigations is the finding that the gender of the target "leaks out" whether the perceiver intends to allow such information to intrude in thinking or not.

Because all but one of the studies conducted to date relied on verbal instantiations of gender, many of the conclusions are restricted to that modality. Moreover, no studies to date have looked at the ability of a picture whose primary meaning is not gender to nevertheless prime gender. Words may prime gender for several reasons. For example, it is possible that because words such as *congressman* or *congresswoman* explicitly indicate gender through gender–specific suffixes, and that terms like *engineer* and *nurse* implicitly do so through gender distribution in the population, gender priming effects are restricted to linguistic representation. Readers of the written word are aware that language is for explicit communication from writer to reader and hence may be vigilant for the meaning that the writer intends. Such a form may be particularly likely to allow stereotypes to be detected because of readers' search for obvious and less obvious meaning and this cognitive run–off may not accrue from pictures.

We are interested in the cognitive power of images encountered every day—images of people and other animate and inanimate objects in the world—to evoke social group meaning. A number of interesting questions emerge from consideration of this issue. Do images evoke gender–specific attributes, even when those images do not contain an image of a person's gender? Are these effects reliably detectable through existing methods to examine social category priming? As with the examples of words like *engineer* and *nurse*, objects such as power tools and kitchen utensils may activate gender concepts because of their relative frequency of use by either men or women. Faces of men and women may activate gender readily, but it would be especially interesting if objects that contained a far weaker cue to gender also produced gender priming. For example, animals such as a furry kitten and a growling dog may activate concepts of femininity and masculinity even though both the kitten and the dog are just as likely to be male as female. In cases such as these, gender is activated not by the sex of the target but by attributes inherent in the essence of the object such as small, soft, and delicate (associated with femininity), and large, aggressive, and strong (associated with masculinity).

Although picture–picture prime–target pairs have not been used in tests of gender priming, pictures have been used to demonstrate semantic association between nonsocial objects. This research typically shows strong effects for picture–picture pairs, indicating that meaning can be extracted automatically from visual representations (Dell'Acqua & Grainger, 1999; Rosch, 1975; Carr, McCauley, Sperber, & Parmelee, 1982). Word–picture priming studies (where a word is the prime and a picture the target or vice versa) have also produced clear priming effects, but such mixed–modality effects are consistently weaker than effects observed with same–modality pairs (e.g., Alario, Segui, & Ferrand, 2000; Guenther, Klatzky, & Putnam 1980; Irwin & Lupker, 1983). As we will show, both within– and between–modality gender priming tests can provide useful information about the importance and automaticity of social category knowledge in thinking.

THE PRESENT RESEARCH

In the present research, we sought to examine how verbal and visual cues to gender can activate knowledge of gender in memory and influence subsequent cognitive processing. We focused on gender activation that occurs relatively automatically, that is, without conscious intention or control (Bargh, 1994). Extending research with verbal stimuli, the first goal of the present research was to test gender priming using a cross–modality design with a novel set of word primes and picture targets. Because cross–modality priming requires stronger underlying prime–target relationships to produce a priming effect compared with same–modality priming, a demonstration of gender priming across modalities would provide particularly strong evidence for the potency of gender as a cue in social information processing.

In Experiment 1, we tested whether words associated with gender through specific linguistic markers (gender–specific suffixes, e.g., chairman vs. chairwoman) or association with stereotypic gender roles (e.g., engineer, nurse) prime judgments of male and female faces. For example, can merely encountering the word *secretary* activate the face of a woman more readily than the face of man? Does the word *congressman* activate male faces more so than the word *congressperson*? The word–picture priming procedure was similar to that used by Kawakami and Dovidio (2001), but whereas they used gender–stereotypic traits as primes, we tested words that represent stereotypic gender roles and words that include gender–specific suffixes.

A second goal of the present research was to demonstrate that visual stimuli can serve as cues to gender concepts in a priming task, even if the images are relatively weakly related to the categories of male and female. In Experiment 2 we tested whether the strong gender priming effect previously obtained with verbal representations exists when the cues to gender are purely visual. We used pictures that directly convey gender (pictures of men and women) as well as those that are merely associated with one or the other group (e.g., an oven mitt vs. a baseball mitt). This allowed us to explore whether visual gender priming effects would emerge even when the objects are relatively weak communicators

of gender, as well as for those that are very strongly gender–related.

EXPERIMENT 1

METHOD

Participants. Thirty–one female and 30 male undergraduates participated in the experiment for course credit or payment of $5.

Materials. Word primes (see Appendix) were selected from Banaji and Hardin (1996). The first group, which will be referred to as "gender–suffix" words, consisted of nine words denoting gender by the presence of the suffix "-man," six by the suffix "-woman," and nine that were more gender–neutral terms such as those including the suffix "–person."[1] A second group of words, which will be referred to as "gender stereotype" words, consisted of roles or professions that are more likely in U.S. culture to be performed by men or women, or equally likely to be performed by either gender (n = 11 for each group). The targets were 36 black and white line drawings of people, half easily identifiable as men and half as women (examples are shown in Figure 1). A paper questionnaire was included to assess explicit ratings of the gender–typicality of each of the prime words using a seven–point scale (1 = *extremely masculine,* 7 = *extremely feminine*; scale endpoints counterbalanced across participants).

Procedure. The priming task used a $3 \times 2 \times 2$ design with prime gender (feminine, masculine, and neutral), target gender (female or male), and prime type (gender stereotype or gender suffix) all manipulated within participants. Data were collected on computers running Inquisit software (Inquisit, 2002). Following an 18-trial practice block, participants completed a 132-trial critical block with gender stereotype primes and a 108-trial critical block with gender suffix primes. For each trial, an orienting stimulus (+) appeared for 500 ms, followed by a prime word for 150 ms, a blank screen for 50 ms, and the target picture, which remained visible until a response was made. The short SOA of 200 ms was

1. Mankind and humankind were also included as masculine and neutral primes, although their gender specifier is a prefix, not a suffix.

FIGURE 1. Sample stimulus pictures from Experiment 1 and Experiment 2. Connotative pictures (used only in Experiment 2) are shown in the top two rows; denotative pictures (used in both experiments) are shown in the bottom row.

chosen to ensure that the measure would tap a relatively automatic process (Neely, 1977, 1991). Participants were instructed to ignore the first picture and make a judgment regarding the second picture of each pair by pressing a key labeled "M" for masculine or "F" for feminine. Block order and key location were

counterbalanced across participants. After the priming task, participants completed paper–based explicit ratings of the gender stereotypicality of the primes and a brief demographic questionnaire.

RESULTS AND DISCUSSION

Manipulation Check on Primes. Across all prime words, explicit ratings corresponded to the appropriate gender ($M_{male} = 2.70$, $SD = .49$; $M_{neutral} = 3.74$, $SD = .28$; $M_{female} = 6.26$, $SD = .77$). Thus, participants agreed with the gender typicality of the primes chosen to represent the three gender conditions.

Preparation of Response Latency Data. Following Blair and Banaji (1996), error trials (3.85% of critical trials) were deleted from the analysis. Trials with latencies greater than +3 *SD* above the mean (1,209 ms, 1.8% of correct trials) were recoded as 1,209 ms, and latencies less than 300 ms (0.2% of correct trials) were recoded as 300 ms. Analyses were performed on log transformed data.[2]

Demonstration of Automatic Gender Stereotype Priming. Prime word type (stereotype vs. suffix) and participant gender did not moderate any effects of prime, target, or their interaction (all *F*s < 1). Thus, analyses on the overall priming effect are collapsed across these variables.

A 3 (prime gender) × 2 (target gender) ANOVA revealed a significant interaction of prime gender and target gender, $F(2, 122) = 41.61$, $p < .0001$, $\eta^2 = .41$. Examination of means from this interaction revealed that word primes facilitated judgments of target pictures following gender–congruent prime words (see Table 1). The fact that this effect emerged so strongly even though the primes and targets were not of the same modality further reinforces the robustness of this activation. Words associated with gender through stereotypes or gender–specific suffixes appear to be very closely linked to their underlying category representa-

2. For clarity of presentation, reported means were re–transformed to raw milliseconds. Analyses conducted on untransformed latencies revealed the same pattern of results across both experiments. Effects that were significant with transformed data were also significant with untransformed data; effect sizes tended to slightly smaller with untransformed data.

TABLE 1. Mean Latency to Respond to Target as a Function of Prime–Target Pairing (Experiment 1)

	Target Gender	
Prime Gender	**Female**	**Male**
Feminine	512_a (64)	542_b (67)
Masculine	536_b (64)	522_b (71)
Neutral	535_a (65)	524_a (72)

Note. Latency measured in milliseconds. Higher values indicate slower responding. Standard deviations are in parentheses. Different subscripts indicate significantly different means within a row, $p < .05$.

tions. Main effects of prime and target, which are not of theoretical interest, were both nonsignificant (Fs < 1).

In the gender priming studies to date, it appears that not only is the pattern strong, the effect is generally symmetrical for male and female conditions. In this experiment, however, the effect was not driven equally by masculine and feminine primes. As shown in Table 1, feminine primes led to significantly faster judgments of female targets than male targets, whereas the priming effect was not significant for masculine primes. This asymmetrical effect may have occurred because the feminine primes were more strongly associated with femininity than the masculine primes were with masculinity. This interpretation is consistent with the finding that explicit ratings of the prime words were not symmetrical. Although the masculine primes were perceived as masculine overall, they were regarded to be less extreme than feminine primes (2.70 out of seven for masculine versus 6.26 out of seven for feminine).

Priming as a Function of Strength of Gender Association. To investigate the relationship between explicit gender–relatedness of the stimuli and the strength of the automatic priming effect, we calculated a priming effect for each prime by subtracting the mean log latency to respond to masculine targets from the mean log latency to respond to feminine targets following each prime. Thus, a positive difference indicates greater feminine facilitation for that prime and a negative difference indicates greater masculine facilitation. The correlation between the average strength of the prim-

ing effect and participants' average explicit gender rating across the 56 prime words was very strong: $r = .74$, $p < .001$. Overall, words that were explicitly most strongly associated with gender tended to produce the strongest priming effects, and words that were rated as relatively gender-neutral tended to produce weak priming effects. This result, for which the units of analysis are stimulus items, complements research using participants as the units of analysis. Such research has documented similar relationships between explicit perceptions and implicit responses (e.g., Cunningham, Preacher, & Banaji, 2001; Greenwald, Nosek, & Banaji, 2003).

These priming results suggested that feminine occupation words and words with female–specific suffixes are very strongly associated with women, whereas masculine occupation words and words with male–specific suffixes are relatively less strongly associated with men, at least at an implicit level. This is consistent with current trends—women are more frequently becoming involved in formerly male–dominated professions, but the number of men in traditionally female–dominated professions is still quite small (Spraggins, 2000). Regardless of one's position regarding the gender–inclusiveness of "masculine generic" terms, it is certainly true that terms such as "congressman" have at least sometimes been used to refer to women, whereas the term "congresswoman" would never be used to refer to a man. The present results may be interpreted to suggest that masculine generic terms are losing some of their gender association as women become more involved in roles that these terms describe. However, it is notable that "-man" suffix words were not perceived to be gender–neutral at an explicit level. The average explicit rating of "-man" suffix words was 2.65, which is significantly more masculine than the neutral scale midpoint of 4.0, $t(61) = 19.72$, $p < .0001$. The "-man" suffix words were also rated as significantly more masculine than the true gender–neutral primes, which included words with "-person" suffixes ($M = 3.74$; $t(61) = 25.24$, $p < .0001$).

Summary. Words that convey gender concepts either through stereotypic association or gender–specific suffixes facilitated gender judgments of male and female faces. The priming effect was considerably stronger for words associated with femininity than with masculinity, possibly because professions that were once al-

most exclusively reserved for men are becoming more widely available to women as well. The experiment provided a novel test of gender activation of occupations and gender–suffix words by demonstrating the effect across prime–target stimulus modality.

Although the cross–modality test demonstrated that words can activate gender sufficiently strongly to prime judgments of pictures, the results do not demonstrate whether gender can be primed exclusively though visual representation. In Experiment 2, we tested whether gender concepts are activated through pictures of people and objects. We included a diverse range of pictures, including pictures that clearly denote gender (pictures of men and women) as well as those that indirectly connote gender through stereotypic association (e.g., sports equipment vs. kitchen appliances). Demonstration that even these more weakly gendered pictures can produce gender priming effects will provide strong evidence for the ubiquity with which gender concepts are activated by the images that we see every day.

EXPERIMENT 2

METHOD

Participants. Twenty female and 20 male undergraduates received $5 to participate in a pretest to generate the stimulus set for the priming experiment. Thirty–nine female and 25 male undergraduates participated in the priming experiment for partial course credit or payment of $5.

Materials. In an extensive pretest, we obtained normative ratings on the gender–relatedness of 900 black and white line drawings and photographs.[3] Pictures were selected from magazines, books, and ClipArt Series illustrations, and were scanned onto a Macintosh computer in grayscale mode, sized to 4 in. × 4 in. at 72 dpi. Undergraduate raters (20 male, 20 female) categorized the pictures as masculine, feminine, or gender–neutral by pressing keys labeled "M" for masculine items, "F" for feminine items, and the spacebar for neutral items. Participants were instructed to

3. These pictures can be requested at www.people.fas.harvard.edu/~banaji.

make judgments of the object–gender relationship "as you believe them to exist in this culture at this time."

One hundred pictures, half of which were rated as more associated with the category "male" and the other half with the category "female" were selected as stimuli on the basis of highest consistency of gender identification (proportion of response: $M_{male} = .96$; $M_{female} = .97$) and shortest latency of judgment (in milliseconds: $M_{male} = 888$, $SD = 145$; $M_{female} = 826$, $SD = 137$). In the priming experiment, across two critical blocks, each picture appeared once as a prime and once as a target. Following data collection, the experimenters categorized the 200 pictures into two categories: stimuli that were obviously *denotative* of gender (i.e., human faces that could be clearly identified as male or female), and stimuli that were merely *connotative* of gender (i.e., pictures associated with gender through gender stereotypes). Fifty–two masculine and 47 feminine pictures were identified as denotative, and 48 masculine and 53 feminine pictures were identified as connotative (see Figure 1 for a sample of pictures from each category).

Procedure . The priming task used a 2×2 design with prime and target (both masculine vs. feminine) manipulated within participants. A third variable concerning the nature of the gender–relatedness of the pictures (connotative vs. denotative of gender) was added in subsequent analyses.

Data were collected using a Macintosh PowerMac running PsyScope experiment software (Cohen, MacWhinney, Flatt, & Provost, 1993). Following a 22–trial practice block, participants completed two critical blocks of 100 trials each, with a rest period between blocks. The procedure for each priming trial was the same as in Experiment 1.

After the priming task, participants completed an explicit rating task in which they were shown 100 of the stimulus pictures, one at a time on the computer screen, and rated each picture by pressing a key on a seven-point scale in which "1" indicated a strong association with masculinity and "7" indicated a strong association with femininity (scale endpoints were reversed for half of the participants). Pictures were chosen at random such that each picture was rated by roughly half of the participants. Participants then completed a questionnaire that probed their understanding of the purpose of the experiment and were debriefed.

RESULTS AND DISCUSSION

Manipulation Check on Primes. Across the 200 stimulus pictures, explicit ratings by the experimental participants of masculine and feminine primes corresponded well to the gender identified in the pre–test ($M_{masculine} = 1.87$, $SD = .49$; $M_{feminine} = 6.20$, $SD = .50$, where 1 = *extremely masculine* and 7 = *extremely feminine*). This result confirms that there was consensus in this sample about the gender stereotypicality of the primes.

Preparation of Response Latency Data. Data were prepared for analysis in the same manner as in Experiment 1. Following Blair and Banaji (1996), error trials (4.5% of critical trials) were deleted from the analysis. Trials with latencies greater than three standard deviations above the mean (1,356 ms, 0.96% of correct trials) were recoded as 1,356 ms, and latencies less than 300 ms (0.2% of correct trials) were recoded as 300 ms. Analyses were performed on log-transformed data.[4]

Demonstration of Automatic Gender Stereotype Priming. Results from the two critical blocks were virtually identical, so all analyses are collapsed across the two blocks. Across all stimuli, masculine and feminine primes strongly activated their corresponding gender. As noted in Table 2, targets were categorized more quickly following gender–consistent primes than gender–inconsistent primes. This effect was evidenced by a significant prime gender by target gender interaction, $F(1, 63) = 26.10$, $p < .0001$, $\eta^2 = 0.29$. Consistent with Experiment 1, main effects of prime and target were both nonsignificant (Fs < 1.0). This result provides support for the generality of the automatic gender stereotype priming effect by showing that gender concepts can be activated through nonverbal pictorial representations of social groups. Also replicating Experiment 1, the priming effect did not vary as a function of participant gender. Because participant gender did not moderate the effect of any other variable, it was not included as a variable in subsequent analyses.

4. For clarity of presentation, reported means were re–transformed to raw milliseconds. Analyses conducted on untransformed latencies revealed the same pattern of results across both experiments. Effects that were significant with transformed data were also significant with untransformed data; effect sizes tended to slightly smaller with untransformed data.

TABLE 2. Mean Latency to Respond to Target as a Function of Prime–Target Pairing (Experiment 2)

	Target Gender	
Prime Gender	**Feminine**	**Masculine**
Feminine	633_a (118)	658_b (91)
Masculine	653_b (95)	640_a (110)

Note. Latency measured in milliseconds. Higher values indicate slower responding. Standard deviations are in parentheses. Means with different subscripts are significantly different, $p < .05$.

Priming as a Function of Stimulus Gender Association. As in Experiment 1, the priming task allowed us to examine the effectiveness of individual primes to facilitate judgments of pictures. A priming effect was computed for each prime picture by subtracting the mean log latency to respond to masculine targets from the mean log latency to respond to feminine targets after each prime. Thus, a positive difference indicated greater feminine facilitation and a negative difference indicated greater masculine facilitation. Across all 200 primes, there was a significant correlation between the average strength of the priming effect and participants' average explicit gender rating of each picture, $r = .45$, $p < .001$. Pictures that were explicitly rated as more strongly associated with one gender tended to produce a stronger facilitation of judgments of pictures of the corresponding gender.

Although the previous analysis indicates that the most strongly gendered primes tend to produce the strongest priming effects, it is possible that that even weakly gendered primes may produce significant priming effects. To test this in our sample of picture primes, we compared the facilitative effects of primes that were clearly identifiable as men or women (pictures denotative of gender) to the facilitative effects of primes that were relatively more weakly associated with gender through stereotypic associations to men and women (pictures connotative of gender).

Not surprisingly, as indicated by a strong main effect of target picture type, $F(1, 63) = 246.37$, $p < .0001$, faces of men and women were categorized much more quickly than target pictures more indirectly associated with gender. The more pertinent question is whether both connotative and denotative pictures are similarly

TABLE 3. Mean Latency to Respond to Target as a Function of Prime and Target Picture Type (Experiment 2)

	Congruency of Gender Pairing				
Prime Type – Target Type	**Match**	**Mismatch**	***F*(1,63)**	η^2	***p***
Denotative–Denotative	613 (107)	640 (90)	20.45	.25	.0001
Denotative–Connotative	661 (111)	681 (99)	11.76	.16	.005
Connotative–Denotative	616 (96)	631 (91)	6.92	.10	.05
Connotative–Connotative	657 (114)	673 (99)	6.38	.09	.05

Note. Latency measured in milliseconds. Higher values indicate slower responding. Standard deviations are in parentheses.

effective in facilitating judgments of other pictures. A marginally significant three–way interaction of prime type × prime gender × target gender indicated that the priming effect was slightly stronger for denotative pictures than for connotative pictures, $F(1,63) = 2.95$, $p = .09$. As shown in Table 3, however, the pattern of responses following the weaker connotative primes was comparable to the stronger denotative primes. Significant gender priming effects were observed for both denotative and connotative primes when paired with both denotative and connotative targets. Thus, connotative pictures (such as an electric mixer or a drill) were effective as primes even though they are as not directly related to gender as the denotative pictures.

The previous analysis indicates that strongly gendered prime–target pairs are not a necessary condition to observe gender priming. Of particular importance is the finding that pictures that connote gender only through stereotypic associations produced significant gender priming effects, showing that masculinity and femininity can be activated even by stimuli that are not primarily intended to communicate that knowledge. Rather, gender concepts pervade ordinary objects and are readily activated upon very brief exposure to such objects.

However, it is noteworthy, although not surprising, that priming effects were somewhat stronger for unambiguously male and female primes than for primes related to gender only through stereotypes. It appears that although priming does occur with rela-

tively weak primes, automatic activation is stronger when the primes are more strongly indicative of gender. As others have noted, weaker associations require more cognitive work to activate the categories of masculinity and femininity, because they are further removed from the underlying concepts (e.g., Carr et al., 1982). This finding is also consistent with research showing that stimuli that are good category exemplars produce stronger priming effects than those that are weak exemplars (Rosch, 1975) as well as with research showing that automatic attitude activation is stronger for stimuli with stronger evaluative association (e.g., Fazio, Sanbonmatsu, Powell, & Kardes, 1986).

Participant Awareness of Hypotheses. In a questionnaire administered after the priming task, 33 of the 63 participants indicated that they were aware to some extent of the purpose of the experiment (e.g., recognizing that the study was about gender stereotypes or that the first picture was not irrelevant to their judgment). The main effects of prime and target and their interaction were not related to whether participants indicated awareness of the purpose of the experiment (all Fs < 1), consistent with other research on automatic priming (e.g., Banaji & Hardin, 1996). This result provides additional support that this measure assesses a relatively less controllable mental process, as responses by participants who were aware of the nature of the task did not differ from those who failed to indicate awareness.

SUMMARY

The results of Experiment 2 provide evidence for the generality of automatic gender stereotyping, extending previous research with word stimuli into the domain of images of persons and objects. Significant priming effects occurred equally for male and female participants with pictures of men and women as well as pictures of objects associated with gender through stereotypes. Relatively stronger priming effects were seen with primes that are more strongly associated with gender, but even weakly gendered primes were sufficient to produce significant priming effects. Thus it appears that gender information is activated by visual

representations of objects, even upon very brief exposure to pictures and drawings of these objects.

GENERAL DISCUSSION

The present studies extend previous research on gender stereotyping, showing that gender–related stimuli—verbal and nonverbal—activate their corresponding gender categories with sufficient strength to influence subsequent judgments. Verbal representations in Experiment 1 demonstrated close links to gender concepts, although this effect was stronger for feminine representations than for masculine. Likewise, strong gender priming effects with picture primes in Experiment 2 imply that visual representations of masculinity and femininity are closely linked to their underlying gender categories. Priming effects were observed even when the primes were relatively weak representatives of gender categories; however, in both experiments the strongest priming effects were observed among primes that were explicitly identified as the most strongly related to gender. Automatic activation of gender concepts appears to be pervasive, with the most irresistible automatic influence reserved for words and objects that are explicitly recognized as being highly representative of their respective gender.

Two explanations are readily apparent for the observed result that stimuli most strongly explicitly related to gender produced the strongest priming effects. First, in both verbal and visual domains, strong exemplars are likely to have more direct links to their underlying categories, resulting in greater activation and thus having a stronger influence on the subsequent target judgments (e.g., Carr et al., 1982; Macrae et al., 2002; Rosch, 1975). Second, with regard to Experiment 2, the more strongly gendered denotative–denotative pairs may have benefited from sharing more visual features compared to the weaker connotative–connotative pairs. Although the pictures varied considerably in their appearance, on average the denotative pictures, which were all pictures of people, were relatively less variable than the connotative pictures, which included animals, tools, toiletries, sports equipment, and more. However, if visual similarity played a role in the priming effects observed in the present study, it was clearly

secondary to the role played by semantic similarities. A man's face shares more visual features with a woman's face than it shares with a drill, but in the present study pictures of men's faces led to faster judgments of power tool targets than of female face targets. Furthermore, word–picture pairs in Experiment 1 shared no visual features, yet strong priming effects were still observed with feminine primes.

The use of pictures as both primes and targets in Experiment 2 provided preliminary evidence that gender priming effects emerge independently of language, and that verbal representations do not need to be provided directly for gender priming effects to emerge. It is possible, of course, that participants were spontaneously generating verbal names in response to the pictures, and using these names to activate gender categories. This seems fairly unlikely, however, because participants were explicitly instructed to disregard the prime picture and because the short SOA (200 ms) gave participants relatively little time to generate names for the primes prior to the appearance of the targets. Also, many of the prime pictures were complex (e.g., two men rowing a boat), making it relatively difficult to generate names for the pictures in the time before the target picture appeared. Future research could provide even stronger evidence that the pictures are not simply being converted into linguistic representation by presenting primes subliminally, so there is no way that participants could be consciously translating pictures into words.

Although connotative primes produced weaker priming effects than denotative primes, it is noteworthy that pictures and words that connote gender only through stereotypic association produced significant priming effects at all. This result clearly demonstrates that masculinity and femininity can be activated even by stimuli that are not exclusively male or female (e.g., sports cars or frilly lampshades, or job titles such as pilot or nanny). Gender concepts pervade ordinary objects and words; even stimuli that do not have an intrinsic gender can bring gender concepts readily to mind upon the briefest exposure.

Experiment 1 provides compelling evidence of gender activation of word primes by demonstrating that gender–related words prime judgments of picture targets, with a particularly strong effect for feminine primes. Previous research using mixed–modal-

ity primes and targets has shown that cross–modality prime–target pairs produce consistently weaker priming effects than same–modality pairs (e.g., Alario et al., 2000, Carr et al., 1982; Sperber, McCauley, Ragain, & Weil, 1979). Impressively, the cross–modality priming effect in Experiment 1 was not only significant, but was very large. The eta–squared effect size of .41 indicates that 41% of the variability in response time to categorize the targets was accounted for by the gender–congruency of the primes. Activation of gender concepts, at least with the primes chosen for the present research, appears to be extremely powerful.

The present research indicated that both pictures and words activate semantically congruent gender categories. However, the experiments did not directly contrast the effectiveness of pictures versus words as primes. Research using nonsocial objects has shown that picture–picture priming effects are even stronger than word–word priming effects (e.g., Alario et al., 2000; Carr et al., 1982; Sperber et al., 1979). In the present research, prime and target modality were not manipulated within a single experiment. Because the semantic content of the primes was so different across the two experiments, in the present research it is not reasonable to compare the results of Experiment 1 and Experiment 2 to determine whether words or pictures are more effective for priming judgments of picture targets. Whether gender–related pictures are more effective primes than gender–related words is a question that must be addressed in future research that manipulates modality within a single experiment. It would be particularly informative to determine whether verbal and visual representations of the same stimuli differ in their effectiveness as primes and targets.

Although Experiment 1 showed that words referring to female–stereotyped gender roles strongly activate gender concepts, it also provided evidence that certain words that bear a linguistic relationship to gender may not automatically activate gender at an implicit level. Results from this experiment using gender–suffix primes suggest that participants have absorbed the cultural norm that a term such as *chairwoman* is never used to refer to a man, whereas *chairman* may in some cases be used to refer to both men and women. The data are agnostic, however, regarding

whether true gender–neutral terms (e.g., chairperson) should be preferred over their generic masculine counterparts in language. There has been considerable debate in the literature regarding whether masculine generic terms such as *businessman* are psychologically inclusive of women as well as men (e.g., Crawford, 2001; McConnell & Fazio, 1996), and the present study certainly does not resolve the debate of whether generic masculine terms should be replaced with ones that are truly gender–neutral. Replacing generic masculine language with gender–neutral terms may be beneficial for many reasons unrelated to automatic gender activation.

A body of emerging research on face perception and face imagining provides hints about the possible implications of the present work. The fusiform face area, located in the fusiform gyrus (FuG), is sensitive to visual images of human faces. The interesting result for our purpose is that actual perception of faces and mere imaging of faces produce nearly identical regions of FuG activation (O'Craven & Kanwisher, 2000). Perhaps even more remarkable is the result obtained by Mitchell, Heatherton, & Macrae (2002), which shows that when semantic judgments are made about inanimate and animate objects (e.g., can *xxx* ever be used to describe *yyy*, where *xxx* is an adjective and *yyy* a person or inanimate object), semantic judgments about people were associated with greater activity in the right FuG (see also Mitchell, Macrae, & Banaji, in press). Together these studies indicate that thinking about psychological attributes of humans spontaneously leads to considering the physical attributes of humans, or else the FuG would not be differentially active when such tasks are performed.

Such images, because they communicate not just humanness but also maleness and femaleness, can shape the downstream choices and decisions that are made because a particular image can suggest the appropriate category. Because they are fleeting and automatic, a choice, such as selecting a woman for a nurse's position and a man for that of a bomber pilot, may feel natural and it is natural, in the sense that it originates from the early and basic mechanics of thought. Nevertheless, our automatic thoughts about gender stereotypes may constrain choices and hamper decision making to the extent that they lock us into particular possi-

bilities and not others. Walter Lippmann (1922) argued that stereotypes are represented as "pictures on our heads." Evidence from gender picture priming suggests that his definition may be literally true.

APPENDIX: WORD PRIMES USED IN EXPERIMENT 1

MASCULINE	FEMININE	NEUTRAL
	Gender Stereotype Primes	
Banker	Ballerina	Administrator
Dentist	Cashier	Artist
Doctor	Goddess	Author
Engineer	Hairdresser	Columnist
God	Homemaker	Deity
Hunter	Librarian	Democrat
Lawyer	Nanny	Entertainer
Mechanic	Nurse	Painter
Pilot	Receptionist	Reporter
Pope	Secretary	Republican
Professor	Typist	Student
	Gender Suffix Primes	
Businessman	Businesswoman	Businessperson
Chairman	Chairwoman	Chairperson
Congressman	Congresswoman	Congressperson
Fireman	Firewoman	Firefighter
Freshman	Policewoman	Frosh
Layman	Salesgirl	Humankind
Mankind		Layperson
Policeman		Policeofficer
Salesman		Salesperson

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