Cognition 136 (2015) 409–416

Contents lists available at ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/COGNIT

Enhanced visual awareness for morality and pajamas? Perception vs. memory in 'top-down' effects

Chaz Firestone *, Brian J. Scholl *

Department of Psychology, Yale University, Box 208205, New Haven, CT 06520-8205, United States[1]

ARTICLE INFO

Article history:
Received 29 April 2014
Revised 21 October 2014
Accepted 26 October 2014
Available online 26 December 2014

Keywords:
Perception
Memory
Morality
Modularity
Top-down effects
Cognitive penetrability

ABSTRACT

A raft of prominent findings has revived the notion that higher-level cognitive factors such as desire, meaning, and moral relevance can directly affect what we see. For example, under conditions of brief presentation, morally relevant words reportedly "pop out" and are easier to identify than morally irrelevant words. Though such results purport to show that perception itself is sensitive to such factors, much of this research instead demonstrates effects on visual *recognition*—which necessarily involves not only visual processing per se, but also memory retrieval. Here we report three experiments which suggest that many alleged top-down effects of this sort are actually effects on 'back-end' memory rather than 'front-end' perception. In particular, the same methods used to demonstrate popout effects for supposedly privileged stimuli (such as morality-related words, e.g. "punishment" and "victim") also yield popout effects for unmotivated, superficial categories (such as fashion-related words, e.g. "pajamas" and "stiletto"). We conclude that such effects reduce to well-known memory processes (in this case, semantic priming) that do not involve morality, and have no implications for debates about whether higher-level factors influence perception. These case studies illustrate how it is critical to distinguish perception from memory in alleged 'top-down' effects.

1. Introduction

What factors determine what we see? A traditional view suggests that perception results from "modular" processes that are encapsulated with respect to higher-level states and so are "cognitively impenetrable" (Fodor, 1983; Pylyshyn, 1999). However, a raft of recent findings falling under the general heading of "top-down" effects has suggested that higher-level factors such as an object's desirability, meaningfulness, and moral relevance can directly influence how (and even whether) we perceive it. For example, it has been reported that people who have fasted for several hours are better able to see food-related stimuli (Radel & Clément-Guillotin, 2012), that assigning linguistic labels to simple shapes makes them easier to visually locate in a crowded display (Lupyan & Spivey, 2008), and that, under conditions of brief presentation, morally relevant words "pop out" in visual awareness and are more accurately perceived than morally irrelevant words (Gantman & Van Bavel, 2014). These and hundreds of other empirical reports have revived claims (previously popular during the "New Look" movement from the middle of the last century) that the basic perceptual processes underlying visual awareness are directly influenced by such higher-level states (e.g. LoSciuto & Hartley, 1963; for a recent review, see Collins & Olson, 2014).

* Corresponding authors. Tel.: +1 203 432 4629; fax: +1 203 432 7172.
E-mail addresses: chaz.firestone@yale.edu (C. Firestone), brian.scholl@yale.edu (B.J. Scholl).
[1] http://www.yale.edu/perception/.

http://dx.doi.org/10.1016/j.cognition.2014.10.014
0010-0277/

1.1. Seeing and recognizing

Top-down effects on perception are framed as effects on what we *see*, but many studies of such phenomena instead report effects on how we *recognize* various sorts of stimuli. By its nature, recognition involves not only visual processing per se but also memory retrieval: in order to recognize something, the mind must determine whether the presented stimulus matches some stored representation in memory. For this reason, any improvement in visual recognition could reflect either an influence on 'front-end' visual processing (in which case it would challenge claims of encapsulated perception) or merely an influence on 'back-end' memory (e.g. influencing how efficiently the relevant memory representations are retrieved).

For example, consider the phenomenon of spreading activation in semantic memory, as studied via priming in a lexical decision task (Meyer & Schvaneveldt, 1971): subjects are faster to recognize a printed word (e.g. "nurse") if they first read a related word (e.g. "doctor") than if they first read an unrelated word (e.g. "butter"). However, this phenomenon clearly has none of the orthodoxy-busting qualities of alleged top-down effects on perception, even though it involves an improvement in visual recognition. Instead, semantic priming is universally understood as an effect on memory (Collins & Loftus, 1975; Masson & Borowsky, 1998; Norris, 1995): reading the word "doctor" activates stored representations of semantically related words such as "nurse", which subsequently become easier to access—not because the actual visual processing changes, but because the standing 'threshold' for activation in memory is lowered (which occurs regardless of whether the word "nurse" is ever presented).

Effects on perception and effects on memory have, to our knowledge, never been explicitly contrasted in this way in contemporary discussions of alleged top-down effects on recognition. If such top-down effects truly reflect influences on 'front-end' visual processing, then they indeed pose a revolutionary challenge to the traditional understanding of visual perception. But the existence of top-down effects on 'back-end' memory is undisputed and pedestrian, having been demonstrated countless times in a wide array of circumstances (and long before any discussions of modularity and cognitive penetrability). Thus, if certain top-down effects merely reflect these sorts of well-known memory processes, they will have no bearing on the foundational issues surrounding higher-level influences on perception (though they may of course be interesting for other reasons).

1.2. 'Moral Popout': visual processing or semantic priming?

We think many alleged top-down effects on perception are explicable as effects on memory rather than on perception. For example, in light of this distinction, consider again the "moral popout effect", whereby morally relevant words were more accurately identified than morally irrelevant words (Gantman & Van Bavel, 2014). In a modified lexical decision task, subjects were briefly shown morally relevant words and morally irrelevant words one at a time over many trials, and the subjects correctly identified more of the morally relevant words than the morally irrelevant words. This result was taken to suggest that morality is "privileged" by the visual system and that "moral concerns shape our basic awareness" (p. 29), a result that by its nature threatens the modular view of perception.

However, simply by virtue of being related to morality, the morally relevant words were also related to *each other* (including, e.g., "justice," "law", "illegal," "crime," "convict", "guilty", and "jail".) By contrast, the morally irrelevant words, having been drawn from a corpus to match the moral words for length and frequency, were not related to anything in particular (including, e.g., "exchange", "rule", "limited", "steel", "confuse", "tired", and "house".) Thus, just as the word "doctor" primes semantically related words such as "nurse", words such as "crime" may have primed semantically related words such as "convict"—whereas words such as "steel" would not have primed unrelated words such as "confuse". In that case, 'moral popout' would simply be another demonstration of semantic priming, with no implications for the relationship between perception and cognition.

1.3. The current studies

The two views of "moral popout" contrasted above make starkly different predictions about how the effect may or may not generalize. If the effect reflects an influence of morality per se on visual awareness, then the effect should be specific to the moral domain (and perhaps related domains of similar importance). But if the effect reflects only spreading activation among related words, then it may have nothing to do with morality at all, and may generalize to *any* group of semantically related words.

Here, we directly tested these competing predictions by asking whether the very same "popout" effect would arise for arbitrary categories with semantically related members, including categories that would be highly implausible candidates for "privileged" status in visual perception. In particular, we employed the same methodology used to demonstrate moral popout (Gantman & Van Bavel, 2014; see also Radel & Clément-Guillotin, 2012) to investigate whether categories such as fashion (Experiment 1) and transportation (Experiment 2) similarly "pop out", and we also replicated the "moral popout effect" itself (Experiment 3). These experiments may serve as a case study of (1) the broader distinction in principle between effects on perception vs. memory, (2) how this difference can be directly tested in practice, and (3) how drawing this distinction can radically alter the proper interpretation of such effects. We conclude by suggesting that this same distinction might force a reinterpretation of several other recently reported effects, and that it should accordingly be front-and-center in any discussion of top-down effects.

2. Experiment 1: a popout effect for 'Fashion'

We first investigated whether words related to 'fashion' (e.g. "pajamas" and "stiletto") would "pop out" in visual awareness, using the same methods as in the original moral popout effect (Gantman & Van Bavel, 2014, Experiment 1).

2.1. Method

2.1.1. Subjects

20 members of the Yale community completed the experiment for monetary compensation. (This sample size matched that of Gantman & Van Bavel, 2014.)

2.1.2. Apparatus

Stimuli were presented on a Dell M992 monitor with a 60 Hz refresh rate, using custom software written in Python with the PsychoPy libraries (Peirce, 2007, 2008). Subjects sat approximately 40 cm from the screen.

2.1.3. Stimuli

496 letter strings were used (see Appendix): 124 fashion words (e.g., "blouse", "dress", "cotton", "slim"), 124 unrelated control words (e.g., "diesel", "limit", "valley", "damp"), and 248 randomly generated anagrams of the 248 words (e.g., "losueb", "rssde", "llayve", "amdp").[2] The control words were drawn from the BYU Corpus of Contemporary American English (Davies, 2008), and were matched for length and approximate frequency. The letter strings were presented in Arial font (up to 1.2° tall), in white print on a black background.

2.1.4. Procedure

On each of 496 trials, a fixation cross appeared in the center of the display for a randomly chosen duration of 100 ms, 200 ms, or 300 ms. The fixation cross was then replaced by one of the letter strings, randomly drawn without replacement from the list of words and nonwords. The letter string remained visible for 50 ms before being replaced by a mask of ampersands of the same length as the string.[3] The mask remained visible for 200 ms, after which subjects pressed a key (with no time constraints) to report whether the stimulus had been a word or a nonword.

2.2. Results and discussion

We observed a 'fashion popout effect' that was entirely analogous to the previous report of 'moral popout': subjects categorized fashion words more accurately than non-fashion words (76.7% vs. 68.1%), $t(19) = 3.59$, $p = .002$, $d = 0.80$ (see Fig. 1).[4]

[2] Gantman and Van Bavel (2014) report using approximately twice as many words as non-words; however, we learned in personal communication that they actually employed an approximately equal number, and so we matched that practice.

[3] Gantman and Van Bavel (2014) reported success with presentation times ranging from 40 ms to 60 ms; however, a monitor refresh rate of 60 Hz (as used here and by Gantman and Van Bavel) should in principle limit presentation durations to multiples of 1/60 s (e.g., 17 ms, 33 ms, 50 ms). We thus chose a duration of 50 ms (3 frames), which is comfortably within the range reported previously (and which, in practice, may have actually been the presentation duration used in the initial studies). Of course, 50 ms itself only approximates the true presentation duration (Elze, 2010).

[4] Following Gantman and Van Bavel (2014), we also analyzed our data using Generalized Estimating Equations. All results reported in this paper are qualitatively unchanged using that statistical technique.

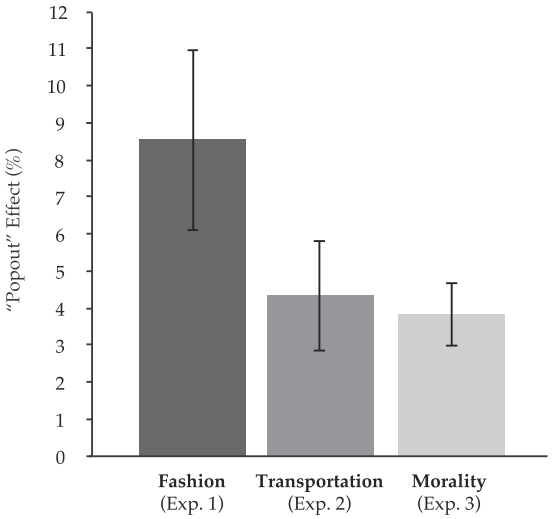

Fig. 1. "Popout" effects from the current experiments. Values on the *y*-axis represent the difference between word/nonword categorization accuracy for the related words and the unrelated words. Error bars are standard errors of the difference scores.

3. Experiment 2: a popout effect for 'Transportation'

To stress the generality and arbitrariness of these "popout" effects, we next replicated Experiment 1 using the category of 'transportation' (e.g. "helicopter" and "gasoline").

3.1. Method

This experiment was identical to Experiment 1 except as noted here. 20 new subjects, all Yale students, completed the experiment for course credit. All subjects were native English speakers. (In Experiment 1, native English speakers showed a stronger popout effect—12.0% vs. 3.4%—so we restricted the current sample to this group.) There were 124 words related to transportation (e.g., "car", "accelerate", "route", "arrival"), 124 new matched control words (e.g., "kid", "compensate", "cream", "fitness"), and 248 nonwords (see Appendix).

3.2. Results and discussion

3.2.1. Transportation popout

We observed a 'transportation popout effect': subjects categorized transportation words more accurately than non-transportation words (82.6% vs. 78.3%), $t(19) = 2.97$, $p = .008$, $d = 0.66$ (see Fig. 1).

3.2.2. Repetition priming (for Experiments 1 and 2)

Our inferences relating to semantic priming above were drawn primarily from a critical feature of the design of the "moral popout" experiment—viz. the fact that morality (and, in our Experiments 1 and 2, fashion and transportation) were perfectly confounded with semantic relatedness. In addition, however, it would be especially decisive to find signatures of semantic priming in the actual data. Given the relatively large number of trials in our experiments, we

looked through our data for a specific sort of event: *repetitions* of category words. (We analyzed both experiments together given the relative scarcity of such repetitions, averaging 25.6 eligible trials per subject. Note in this respect that Gantman and Van Bavel might not have been able to run this analysis for their studies, given that they used many fewer trials.) Across Experiments 1 and 2, performance on a word from a given category (fashion or transportation) was better when the immediately preceding trial also happened to come from that same category (e.g., "dress" preceded by "shirt", or "car" preceded by "bus") than when it happened to be preceded by a control word (e.g., "dress" preceded by "earth", or "car" preceded by "egg"; 81.3% vs. 76.0%). This advantage was selective: performance on control words was not better when the previous trial was a category word than when it was a control word (72.7% vs. 74.8%). In other words, a trial's word type interacted with the magnitude of the "popout" effect on the subsequent trial, such that category words conferred a 7.4% 'preferential advantage' on subsequent category words, $t(39) = 2.67$, $p = .011$, $d = 0.42$. This sort of advantage for repetitions is a telltale signature of semantic priming (and indeed was the basis for the original demonstration of semantic priming in a lexical decision task; Meyer & Schvaneveldt, 1971), but it would not be predicted by any "popout" account based on a privileged categorical status. As such, this analysis assured us not only that words from arbitrary categories are similarly prioritized, but also that semantic priming in particular influences detection rates in these "popout" experiments.

4. Experiment 3: moral popout replication

To examine how fashion and transportation compare to morality in terms of "popout" (both in magnitude and regarding evidence for semantic priming), we next replicated the moral popout effect.

4.1. Method

This experiment was identical to Experiment 2 except as noted here. 40 new members of the Yale community completed the experiment for monetary compensation. (6 of 40 subjects were non-native speakers, compared with 8 of 40 across the previous two experiments.) We added 84 moral words to Gantman and Van Bavel's (2014) 40 moral words, for a total of 124 moral words. There were 124 new matched control words, and 248 nonwords (see Appendix).

4.2. Results and discussion

4.2.1. Moral popout

We successfully replicated the moral popout effect: subjects categorized moral words more accurately than non-moral words (79.8% vs. 75.9%), $t(39) = 4.49$, $p < .001$, $d = 0.71$. The strength of this effect was comparable to those of the other categories we tested (in terms of both effect size and the brute%-difference in accuracy between category words and noncategory words; see Fig. 1), and the 3.9% advantage for moral words very closely matched Gantman & Van Bavel's meta-analytic estimate of 4% for their various studies of this effect. Interestingly, several subjects explicitly articulated our exact semantic priming hypothesis during their formal debriefing. For example, one subject, when asked whether and when she noticed the presence of moral words, said: "I didn't think about morality. If you had put 'fire hydrant' and 'dog' together, that would have made sense to me, too. Or 'umbrella' and 'rain'."

4.2.2. Repetition priming

When repetition priming was analyzed exactly as described for Experiments 1 and 2 (here with an average of 23.4 eligible trials per subject), we observed a marginally significant 'preferential advantage' for moral–moral repetitions, $t(39) = 2.00$, $p = 0.053$, $d = 0.32$. However, during their formal debriefing, many subjects described the task not as involving *moral* words, but instead as involving both positive and negative words. For example, when asked what he thought we were testing, one subject began his answer by noting: "The words seemed to be a combination of three categories: good things, bad things, and random things." As such, we acquired valence ratings for the moral words in a followup analysis, using a simple norming study on Amazon Mechanical Turk.[5] This analysis categorized each of the moral words as either positive (36 words, e.g., "hero"), negative (78 words, e.g., "evil"), or neutral (10 words, e.g., "should"). When we restricted the repetition-priming analysis to positive–positive and negative–negative repetitions (rather than simply moral–moral repetitions), the preferential advantage was 5.2% and was more robust (despite there being an average of only 11.4 eligible valence-congruent repetitions per subject), $t(39) = 2.26$, $p = 0.029$, $d = 0.36$. Thus, the semantic priming that explains so-called "popout" with morality may in fact reflect two relatively independent priming effects—a good–good priming effect ("positive moral popout") and a bad–bad priming effect ("negative moral popout")—which, if true, is consistent with the fact that the popout effect was no larger or stronger for moral words than for fashion or transportation words.

5. General discussion

The results reported here are intended not to criticize particular experiments, but rather to serve as case studies of three more general points:

First, our results highlight the importance of explicitly distinguishing perception from memory in top-down effects. Here we have suggested that one such effect—"moral popout"—should be interpreted in terms of 'back-end' memory retrieval rather than 'front-end' visual processing. In this effect, morality was essentially

[5] 35 subjects each rated all 248 moral and control words on a 7-point scale from "very negative" to "very positive" (with "4" being "neither positive nor negative"). There was some disagreement about the valence of certain words (e.g., "confess"), so we categorized words as "negative" if their modal response was negative, "neutral" if their modal response was neither positive nor negative, and "positive" if their modal response was positive. (3 'ties' between neutral and valenced interpretations were broken for the valenced interpretations, to err on the side of increasing the number of trials in the analysis.)

confounded with semantic relatedness—an otherwise-subtle property that becomes obvious when the effect is interpreted in terms of semantic priming and spreading activation. This type of distinction between perception and memory is almost never explicitly discussed in contemporary reports of top-down effects, but we suggest that it applies in principle to any such effect involving recognition (e.g. of what word was presented) instead of brute *seeing* (e.g. of how bright a stimulus was).

Second, we showed how this is not a vague theoretical objection, but is rather a straightforward and directly testable empirical matter. Here, the same methods used to demonstrate popout effects for supposedly privileged stimuli also yielded popout effects for unmotivated, superficial categories (such as fashion-related words). This generalization is predicted by the priming-based account but is not consistent with the view that visual processing is enhanced for certain prioritized stimulus categories. Moreover, this experimental strategy does not rely on any null effects, but instead provides empirical evidence by replicating the target phenomena in situations where they should not apply (cf. Firestone & Scholl, 2014, who employed a similar strategy for alleged top-down effects unrelated to either visual recognition or the perception/memory distinction).

Third, our approach aims to highlight how and why the distinction between perception and memory in this context really *matters*. This seems especially well illustrated by the present case study, insofar as the perceptual explanation is specific to morality, whereas the priming-based explanation has nothing to do with morality. In short, we suggest that "moral popout" involves neither properly visual popout *nor morality*. As such, the priming-based account readily accommodates additional findings regarding the effect. For example, the magnitude of the original moral popout effect did not correlate with individual differences in morality-related attitudes (Gantman and Van Bavel, 2014). This might seem mysterious if the effect is truly related to "moral concerns" (p. 29), but of course it is exactly what the priming account (in which morality plays no role) would predict.

5.1. Perception vs. memory in other top-down effects?

We think that many other reports of top-down effects on recognition similarly fail to distinguish perception from memory, even when this distinction is theoretically central and empirically testable. For example, subjects who had fasted for several hours before an experiment were better able to identify briefly presented stimuli (including printed words) if those stimuli related to food, which was interpreted as an effect on "early visual perception" (Radel and Clément-Guillotin, 2012). However, if hungry subjects were simply *thinking about food* more than non-hungry subjects were (which seems plausible), then it is to be expected that they should more easily identify food-related stimuli—not because the visual system has access to information about hunger, but rather because thinking about food makes it easier to retrieve food-related memory representations. (Analogously, we would not be surprised to discover that 'fashion popout' is enhanced for subjects who are shopping for new clothes.)

Similarly, it has been reported that assigning linguistic labels to meaningless squiggles (e.g., noticing that one squiggle looks like a '2') makes the squiggles easier to locate in a crowded display (Lupyan and Spivey, 2008). However, this too could be an effect on memory rather than perception, if it is easier for the mind to *match* the squiggle to a previously stored memory representation than to create such a representation anew—even with no differences in initial visual processing.

5.2. Conclusion

Many claims of top-down effects in visual perception rest on demonstrations that visual recognition can be influenced by higher-level states. However, it is crucial when evaluating such effects to distinguish between effects on perception and effects on memory, given the roles played by each in recognition. Indeed, we think that this distinction should be front and center in any discussion of top-down effects that involve recognition. Here, we showed that this distinction can be made not only in principle, but also in practice: it is a perfectly tractable empirical question to separate effects on perception from effects on memory.

Acknowledgements

For helpful conversation and/or comments on earlier drafts, we thank Adam Bear, Jeremy Cone, Ana Gantman, Monica Rosenberg, and Jay Van Bavel.

Appendix

Fashion	Fashion control	Transportation	Transportation control	Morality (*G&VB*)	Morality control
shirt	earth	car	kid	*moral*	broad
skirt	array	bus	egg	*hero*	core
pants	bells	train	dress	*blame*	grant
jeans	rails	plane	scale	*virtue*	ballot
shorts	pupils	road	wife	*injure*	endure
underwear	offspring	bicycle	texture	*save*	push
sweater	harmony	skateboard	turtleneck	*should*	become
blouse	diesel	motorcycle	newsletter	*ought*	adopt

(*continued on next page*)

Appendix (*continued*)

Fashion	Fashion control	Transportation	Transportation control	Morality (*G&VB*)	Morality control
sock	pork	truck	crowd	*just*	then
shoe	wave	wagon	thigh	*justice*	chicken
jacket	desert	vehicle	context	*jail*	cake
umbrella	revision	transportation	interpretation	*punish*	cancel
glove	rifle	wheel	cable	*protest*	counter
mittens	archers	tire	coin	*victim*	dinner
stiletto	clubface	motor	cabin	*evil*	rent
sneakers	platters	engine	planet	*law*	car
tie	sir	drive	break	*convict*	reverse
robe	vein	steer	cheer	*right*	there
cotton	valley	navigation	exhaustion	*wrong*	short
wool	prey	direction	interview	*responsible*	independent
polyester	financier	map	lip	*guilty*	narrow
spandex	integer	highway	lawsuit	*pain*	unit
belt	corn	speed	grade	*punishment*	helicopter
clothing	boundary	accelerate	compensate	*fair*	tall
fashion	holiday	brake	squad	*kill*	send
purse	shark	sedan	badge	*religion*	baseball
handbag	kickoff	street	chance	*hate*	hire
scarf	chore	lane	nest	*god*	jet
shawl	dummy	traffic	silence	*violate*	sustain
garment	artwork	trunk	elbow	*sin*	toe
silk	bath	subway	supper	*confess*	oversee
dress	limit	station	manager	*judge*	sleep
leggings	spindles	terminal	preacher	*steal*	solve
shoelace	overpass	route	cream	*crime*	glass
coat	mark	passenger	selection	*fault*	honey
stocking	dwelling	gear	wage	*innocent*	accurate
earrings	cabbages	pedal	paste	*illegal*	massive
bracelet	charcoal	move	hold	*forbid*	soften
ring	nose	path	folk	*ideal*	tight
necklace	landlord	carriage	comeback	*devil*	trout
hat	tip	tunnel	rhythm	greed	salon
vest	pear	boat	hole	unethical	cavernous
gown	solo	ship	camp	wicked	timely
pajamas	gunfire	helicopter	punishment	corrupt	unaware
suit	gift	jet	cow	dishonest	unarmed
cardigan	tutorial	gasoline	monument	honorable	energetic
overalls	pumpkins	diesel	parlor	suffering	touchdown
fleece	atrium	windshield	sunglasses	hell	gift
boot	iron	cruise	mentor	heaven	button
denim	vista	bridge	bottle	spite	apart
bikini	sludge	bumper	parody	righteous	intrusive
sleeve	trauma	accident	governor	noble	rigid
button	phrase	crash	label	decent	casual
thread	palace	garage	comedy	integrity	diagnosis
linen	coral	flight	aspect	dignity	romance
hood	taxi	shuttle	pension	biblical	stunning
luxedo	ransom	trip	edge	altruism	woodwork
leather	protest	tour	tape	violence	marriage
sunglasses	extinction	railroad	freshman	perpetrator	contingency
zipper	homage	dashboard	interplay	murder	border
wear	pick	commute	distort	accuse	reject
stitch	engulf	travel	finish	compassion	adaptation
hem	sub	journey	absence	purity	citrus
lace	hull	ride	gain	demon	choir

Appendix (*continued*)

Fashion	Fashion control	Transportation	Transportation control	Morality (*G&VB*)	Morality control
pocket	planet	arrival	fitness	assault	episode
poncho	docket	departure	collector	incest	ransom
leotard	collard	fly	act	cheat	blink
fabric	fellow	pilot	frame	deceive	lighten
satin	deity	airport	bedroom	help	turn
velvet	saddle	pavement	bulletin	harm	beam
lining	ballad	asphalt	butcher	hinder	delete
stylish	sizable	boulevard	prognosis	hurt	born
casual	decent	fuel	poll	vile	wavy
preppy	snooty	tailgate	playbook	sinister	assorted
knitting	streamer	scooter	lodging	cruel	sunny
turtleneck	illiteracy	yacht	chord	angel	input
sweatshirt	watermelon	sail	ruin	saint	witch
apron	chili	trail	storm	deity	satin
windbreaker	romanticism	hubcap	uptick	piety	opium
sandals	cinemas	cab	web	holy	pink
cap	toy	taxi	soda	devout	ardent
nightgown	manifesto	limousine	alligator	conscience	projection
headband	buzzword	compass	heroine	traitor	caravan
slippers	drummers	destination	reliability	betray	strive
nylon	curry	freeway	outlook	disloyal	cavalier
waistline	archivist	pedestrian	repertoire	faith	river
tailor	marvel	tourist	stomach	inflict	signify
seamstress	chalkboard	fender	incest	torment	clutter
textile	clarity	embark	inhale	felony	fusion
sequin	cougar	voyage	bunker	atrocity	boutique
swimsuit	futility	transit	militia	abomination	exclusivity
mannequin	riverbank	ferry	bloom	hostile	shallow
lingerie	megawatt	automobile	popularity	shame	opera
undershirt	deflection	locomotive	assemblage	divinity	outburst
collar	stance	interstate	prosperous	transgression	enlightenment
attire	thirst	avenue	magnet	infidelity	impatience
weave	hover	sidewalk	wildlife	adultery	backseat
yarn	lobe	overpass	shoelace	covet	poach
apparel	anomaly	swerve	tether	envy	flex
pullover	trickery	van	pig	profane	furtive
flannel	rebirth	trolley	steroid	misconduct	alteration
wrinkled	outdated	takeoff	lookout	praise	bounce
baggy	leafy	runway	intake	prison	winter
uniform	fighter	submarine	remainder	jury	leaf
designer	criteria	mileage	coaster	naughty	pitiful
vintage	volcano	canoe	width	selfish	chaotic
trendy	finite	kayak	plaid	kindness	tortilla
laundry	vinegar	monorail	gigabyte	value	price
matching	accepted	propeller	cartilage	reprehensible	uncomplicated
striped	pivotal	rocket	carpet	obscene	defiant
comfortable	appropriate	sled	slit	vulgar	barbed
model	value	seatbelt	knockoff	malice	strait
drawer	inmate	trailer	romance	forgive	confuse
dresser	asphalt	buggy	haste	allege	enlist
jersey	asylum	streetcar	lifeguard	liar	turf
pouch	levee	snowmobile	witchcraft	culpable	middling
frilly	leaden	airbag	upkeep	lust	loft
heels	aides	tricycle	lyricist	sanctity	artistry
elegant	teenage	driveway	headache	chaste	clunky
slim	damp	stroller	ligament	obligation	proportion

(*continued on next page*)

Appendix (*continued*)

Fashion	Fashion control	Transportation	Transportation control	Morality (*G&VB*)	Morality control
outfit	streak	crosswalk	locksmith	duty	hall
mesh	maze	stoplight	glassware	revenge	revival
boxers	vapors	horsepower	countertop	humble	absurd
strap	setup	honk	mash	heinous	lovable

References

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82*, 407–428.

Collins, J., & Olson, I. (2014). Knowledge is power: How conceptual knowledge transforms visual cognition. *Psychonomic Bulletin & Review, 21*, 843–860.

Davies, M. (2008). *The Corpus of Contemporary American English: 450 million words, 1990-present*. <http://corpus.byu.edu/coca/>.

Elze, T. (2010). Misspecifications of stimulus presentation durations in experimental psychology: A systematic review of the psychophysics literature. *PLoS ONE, 5*, e12792.

Firestone, C., & Scholl, B. J. (2014). "Top-down" effects where none should be found: The El Greco fallacy in perception research. *Psychological Science, 25*, 38–46.

Fodor, J. A. (1983). *The modularity of mind: An essay on faculty psychology*. Cambridge, MA: MIT Press.

Gantman, A. P., & Van Bavel, J. J. (2014). The moral pop-out effect: Enhanced perceptual awareness of morally relevant stimuli. *Cognition, 132*, 22–29.

LoSciuto, L. A., & Hartley, E. L. (1963). Religious affiliation and open-mindedness in binocular resolution. *Perceptual and Motor Skills, 17*, 427–430.

Lupyan, G., & Spivey, M. J. (2008). Perceptual processing is facilitated by ascribing meaning to novel stimuli. *Current Biology, 18*, R410–R412.

Masson, M. E., & Borowsky, R. (1998). More than meets the eye: Context effects in word identification. *Memory & Cognition, 26*, 1245–1269.

Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology, 90*, 227–234.

Norris, D. (1995). Signal detection theory and modularity: On being sensitive to the power of bias models of semantic priming. *Journal of Experimental Psychology: Human Perception and Performance, 21*, 935–939.

Peirce, J. W. (2007). PsychoPy—Psychophysics software in Python. *Journal of Neuroscience Methods, 162*, 8–13.

Peirce, J. W. (2008). Generating stimuli for neuroscience using PsychoPy. *Frontiers in Neuroinformatics, 2*.

Pylyshyn, Z. W. (1999). Is vision continuous with cognition? The case for cognitive impenetrability of visual perception. *Behavioral and Brain Sciences, 22*, 341–365.

Radel, R., & Clément-Guillotin, C. (2012). Evidence of motivational influences in early visual perception: Hunger modulates conscious access. *Psychological Science, 23*, 232–234.