Frequency of occurrence and rankings for touch-related adjectives

LEE M. STADTLANDER and LATONA D. MURDOCH
Montana State University, Bozeman, Montana

A three-phased study was conducted in order to develop a standardized list of touch-related adjectives. The final list consisted of 306 words that were categorized in 440 instances according to the Lederman and Klatzky (1987, 1990) dimensions of haptic properties (some words were classified in more than one dimension). The Kučera and Francis (1967) frequency of occurrence in written English for all words in the final list was also determined. A correlation was found between frequency of occurrence on the list and Kučera and Francis frequency. An analysis of the word dimensions and future applications are discussed.

Recently, the authors sought a list of touch-related adjectives in order to prime subjects in a memory task. Much to their surprise, they discovered that there was no such listing in the literature, although listings were present for abstractness and meaningfulness (Arnold, 1980; Ellis, 1991; Klee & Legge, 1976), imagery (Gilhooly & Hay, 1977), and combinations of the three (Friendly, Franklin, Hoffman, & Rubin, 1983; Toglia & Battig, 1978). A number of questions were then raised. If subjects were to list touch-related adjectives, would their responses be correlated with frequency of occurrence in written language (as measured by Kučera & Francis, 1967)? How would such a listing compare with the haptic (active touch) dimensions identified by Lederman and Klatzky (1987, 1990; detailed below)? Would there be a difference in the number and type of words listed when subjects were told simply to list adjectives to describe objects, as opposed to specifically listing touch-related adjectives?

One of the few areas in which touch-related adjectives have been explored previously relates to the manufacturing of textiles and is called *fabric hand*. Fabric hand is used to describe fabric quality and suitability for specific uses. Some researchers have defined fabric hand as a subjective property evaluated by people (Brand, 1964; Schwartz, 1939). Kim and Winakor (1996) attempted to develop sets of adjectives for consumer evaluation of fabric hand for English and Korean speakers. However, typical of research in this area, Kim and Winakor's work is based on psychophysical evaluation of specific stimuli, as opposed to memory of the words.

Lederman and Klatzky (1987, 1990) identified haptic dimensions on the basis of subjects' exploration of objects: roughness, hardness, temperature, weight, part motion, shape, volume (i.e., size), and specific function. The authors found that particular dimensions were directly related to the way in which the object was explored (see also Hollins, Fladowski, Rao, & Young, 1993, and Lederman, Klatzky, & Reed, 1993, for extensive discussions of haptic attributes). But as we move from the perceptual world to memory, what is the relationship between the haptic dimensions and words that are used to describe objects? Is there any reason to believe that some dimensions would produce more words than other dimensions? In the present study, these issues are explored.

In the first phase of the study, the subjects were told to list adjectives describing objects, then to go through the list and indicate the relevant sensory system (sensory list). It is theorized that these instructions should produce a predomination of vision-related words, since this sense tends to dominate over all others (Lederman & Abbott, 1981). However, this theory has not been previously tested using the proposed methodology. In the next stage of the study, the subjects were instructed to list only touch-related adjectives (touch-focused list). It was speculated that this list would include more of the haptic-related properties listed by Lederman and Klatzky (1987, 1990): roughness, hardness, temperature, weight, shape, size, and part motion. In the final phase of the study, rankings were developed for each of the words.

METHOD

Subjects

One hundred twenty volunteers from introductory psychology courses at Montana State University–Bozeman were recruited for the first phase of the study. Seven upperclassmen, graduate students, and faculty members participated in Phase 2. Twenty volunteers from introductory psychology courses participated in the third phase. No subjects engaged in more than one phase of the study.

Procedure

Phase 1: Development of an initial list of adjectives. The subjects were given 10 min to list as many descriptive terms or adjectives for describing objects as possible. Next, they were asked to go back over their lists and indicate for each word what sense it referred to, such as vision, hearing, smell, touch, or taste, using specific abbreviations (sensory condition). In addition, they were instructed to circle the sense they thought was the most appropriate for the word. Finally, the subjects were given 5 min to list as many adjectives as possible that described an object through the sense of touch. They were told to consider what an object would feel like if their eyes were closed and they were exploring it (touch-focused condition).

The mean number of words listed by the subjects as being most appropriate for each sense in the sensory condition, along with the mean number for the touch-focused list, is shown in Table 1. The focus of the present study was on touch-related words; therefore, the lists of adjectives were then compiled for the touch-designated words in the sensory condition and for the touch-focused condition, resulting in 507 words.

Phase 2: Assignment to Lederman and Klatzky (1987, 1990) dimensions. The compilation of the 507 words developed in Phase 1 was used in Phase 2. Seven upperclassmen, graduate students, and faculty were recruited as judges to rank each word based on a continuous dimension—texture (roughness to smoothness), hardness (hardness to softness), temperature (hot to cold), weight (heavy to light), and size (large to small)—on a scale with a range of +7 to −7. The words on a discrete dimension—part motion (movement to no movement) and shape (distinct to ambiguous)—were to be ranked on a scale with a range from 0 to +7. For the present purposes, part motion differed from Lederman and Klatzky's (1987, 1990) definition. Lederman and Klatzky used specific categories of motion relative to the body of an object (e.g., linear vs. rotary). In the present study, since the subjects relied on memory, as opposed to direct perception of objects, the judges were asked to evaluate whether the word referred to any possible movement made by an object part. The dimension of shape was to be ranked on the basis of the definitiveness of the shape associated with a particular word. Thus, the more specific the shape associated with a word, the higher its ranking. The judges were instructed to rank each of the words on all of the dimensions. A ranking of zero meant the word did not exhibit that dimension. Specific rankings were ignored for the present purposes; words from the compilation list were included in Phase 3 if at least 4 of the 7 judges rated the absolute value of the word as above zero on a given dimension. A total of 440 instances of the dimensions occurred within 306 words (some words were classified in more than one dimension). A total of 201 words were judged as unclassifiable in this task.[1]

Phase 3: Final rankings. Twenty undergraduates were asked to rank each of the 440 words on the dimensions of Lederman and Klatzky (1987, 1990) identified as relevant in Phase 2. Again, the rankings were based on a continuum of +7 to −7 for the following

continuous dimensions: roughness to smoothness, hardness to softness, temperature, weight, and size. The subjects were given sets of index cards. Each card listed a word previously classified on a specific dimension. The subjects were instructed to select the most extreme words for that dimension and to use these extreme values as anchor points for the rest of the words in that dimension. They then arranged the remaining word cards in that set on a scale of −7 to +7 that had been drawn on a large sheet of paper. The judges were instructed to use the ranking of zero if the word did not, in their opinion, exhibit the dimension.

A similar procedure was used for the discrete dimensions of part motion and shape. The subjects were instructed to use the most extreme example as an anchor point of +7 (e.g., the word that represented the most definite shape/motion) to 0 (no apparent shape or motion). They then arranged the rest of the cards for the dimension in reference to this point. The Appendix lists the 306 identified words, frequency of occurrence on the sensory and touch-focused lists from Phase 1, dimensions identified in Phase 2, the rankings from Phase 3, and Kučera and Francis (1967) frequency of occurrence in written English.

RESULTS AND DISCUSSION

An examination was made of the sensory condition list. The mean number of items from each of the five senses is shown in Table 1. It is evident that the visual system dominated all others. A repeated measures t test between numbers of visual ($M = 26.62$, $SE = 10.9$) and touch-related ($M = 14.09$, $SE = 1.85$) words listed per subject, confirmed that the visual sense dominated on this list [$t(119) = 11.79, p < .001$].

In Phase 3, rankings were determined for each word on the previously identified dimensions (a full listing is provided in the Appendix). These rankings should be taken as *relative frequency measures*; thus, a word high on the given scale shows more of the attribute than does a word with a lower ranking. A strong relationship was found between frequencies of occurrence for the sensory and the touch-focused lists [$r(306) = .95, p < .01$]. Thus, if the subjects listed the word on one list, they tended to include it on the second list. There was no relationship between dimension type (roughness, hardness, etc.), mean ranking, and frequency of occurrence in list ($ps > .10$). In addition, a correlation was present between frequency of occurrence on the sensory list [$r(304) = .25, p < .01$] and Kučera and Francis (1967) frequency, as well as between frequency on the touch-related list [$r(304) = .23, p < .01$] and Kučera and Francis frequency. This finding confirms that words that are common in written English (i.e., high frequency) according to the Kučera and Francis listing were recalled at a higher rate on the present task, whereas less common words (i.e., low frequency) were recalled at a lower rate.

A summary of the data from Phase 3 is shown in Table 2. Overall interrater reliability was strong [$r(18) = .60, p < .01$]. There was more consensus between the raters for dimensions that use a continuous scale [temperature, weight, size, hardness, and roughness; $r(18) = .76, p < .01$] than for those on a discrete scale [part mo-

Table 1
Phase 1: Mean Number of Words Listed Per Subject for Each Sensory Designation and List Type

List	Mean
Sensory-focused	
Visual	26.21
Touch	14.09
Taste	3.13
Hearing	1.97
Smell	1.23
All sensory	43.64
Touch-focused	24.30

Table 2
Phase 3: Listing of Frequency of Dimension Occurrence*

Dimension	n	Interrater Reliability	Mean Ranking	Mean SD	Example
Temperature	29	.81†	0.26	1.69	chilly
Weight	29	.78†	3.91	2.17	heavy
Size	30	.83†	0.13	1.86	big
Part motion	32	.38	3.63	3.56	flexible
Shape	60	.30	4.12	2.11	circular
Hardness	105	.73†	−0.39	2.28	rigid
Roughness	155	.70†	0.11	2.51	bumpy

Total number = 440, Overall interrater reliability = .60†

*Some words are classified in more than one dimension.   †$p < .01$.

tion and shape; $r(18) = .34, p > .10$]. In addition, more words on a continuous scale were listed ($M = 69.5$) than words on a discrete scale ($M = 46.0$). Words on a continuous scale appear to provide more degrees of differentiation than do those on a discrete scale. For example, the textural dimension of roughness to smoothness has many possible descriptions between the extreme values of rough and smooth: *bumpy, sandy, grainy, sleek, slippery*, and so forth. On the other hand, consider such dimensions as shape or part motion. These words are not on a continuous scale; rather, they tend to be more discrete or absolute entities, such as *circular*, or *pulsating*. It appears that the subjects may have used different defining dimensions for these discrete dimensions; thus, readers are advised to use these norms with caution.

Furthermore, continuous dimensions of words that use a standard measurable scale (e.g., weight, kilograms or pounds; temperature, Fahrenheit or Celsius; and size, centimeters or feet) showed more interrater consensus [$r(18) = .84, p < .01$] than did those without a standard scale of measurement [hardness and roughness; $r(18) = .73, p < .01$]. One possible explanation for the lower interrater reliability for the hardness and roughness dimensions is that these dimensions may be object and material dependent. For example, when required to rank the roughness of the word *aluminum*, one individual may have in mind aluminum foil, whereas another individual may

have in mind an unfinished piece of aluminum. This subjectivity leads to ambiguity of definition for many of the hardness and roughness words.

A total of 77 words were judged in more than one dimension. As is shown in Table 3, 78% of these words were composites of hardness and roughness. This is consistent with the observation that the composite words tend to be material-related terms, such as *cloth, steel*, and *velvet*. Materials can yield various combinations of hardness and roughness, whereas combinations of other dimensions, such as roughness and weight, do not typically occur. Thus, it is difficult to achieve a consensus on the meaning or definition of many of these adjectives without using additional descriptors, comparing specific materials, or naming the referenced object.

Future applications of these word lists may occur in several fields. Within psychology, experiments can investigate the priming of words for objects and of objects for words. It would also be interesting to explore differences in priming for discrete versus continuous scale adjectives. As scientists begin to explore human interactions with objects, using more cognitively complex protocols—for example, using virtual environments—the descriptors used by subjects and experimenters will need to become increasingly complex as well. This will require a more sophisticated terminology, of which the present study provides only the beginning. These lists need to be standardized for experimental use. This is especially true as we begin to use virtual technology in a laboratory setting. These lists may also be used to develop sets of adjectives that can be used in consumer and psychological studies and that are based on higher order cognitive processing, as opposed to only sensory level stimulation. These types of adjectives could prove valuable in consumer or ergonomic studies to distinguish between psychophysical stimulation and memory or experience with objects. In addition, there may be applications within the advertising field. Words that appeared to be more ambiguous in the present study may be less likely to evoke the emotional response desired by advertisers. Qualitative researchers may wish to use the words to evaluate

Table 3
Phase 3: Number of Words in Composite Dimensions

Dimension	Temperature	Weight	Size	Part Motion	Shape	Hardness	Roughness
Weight							
Size		3					
Part motion							
Shape			1				
Hardness	1	4			2		
Roughness		1		2	3	41	

Other composites:
Roughness, hardness, part motion	4
Roughness, hardness, shape	7
Roughness, hardness, temperature	1
Roughness, hardness, weight	6
Roughness, hardness, weight, shape	1

responses to open-ended questions regarding human–object interactions.

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NOTE

1. In Phase 2, 201 words were judged as unclassifiable. It was determined that these words tended to be egocentric adjectives reflecting the person's perspective or value judgment (e.g., *abusive, simple, tired*), as opposed to an adjective describing the sensory experience, or object-related words that did not fit the dimensions in Phase 2 (e.g., *worn, old, organic*). The unclassifiable words tended to come from the sensory list [$r(192) = .30, p < .01$].

APPENDIX
Listing of All Words and Mean Dimension Rankings, With Standard Deviations

Touch-Related Adjective ($n = 24$)	Sensory List Frequency ($n = 120$)	Touch-Focused Frequency ($n = 120$)	K&F Frequency	Hardness, −7 (Soft) to +7 (Hard)		Part Motion,† 0 to +7		Roughness, −7 (Smooth) to +7 (Rough)		Shape,† 0 to +7		Size, −7 (Small) to +7 (Large)		Temperature, −7 (Cold) to +7 (Hot)		Weight, −7 (Light) to +7 (Heavy)	
				M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
abrasive	3	6	0	4.2	2.0	0.4	0.8	6.3	1.0								
aluminum*	1	1	18	1.8	2.3			−2.6	3.1							−0.5	3.2
angular	3	1	16							4.6	2.1						
asymmetrical	2	2	2							3.0	2.9						
bald	6	7	5					−4.1	3.0								
barbed	1	1	11	3.6	4.0			6.3	1.7	3.6	2.9						
bark*	1	1	14	1.9	3.1			4.3	2.1							−0.2	3.4
beaded	1	1	1	1.5	3.1			3.0	2.4	3.3	2.4						
bendable	3	5	0			4.3	2.1										
bent	3	4	34							3.6	2.4						
big	19	18	360									4.4	2.1				
binding	1	2	20			1.6	1.9										
blunt	2	4	9					0.5	3.8								
bony	1	3	7	4.3	2.3			2.5	2.3	2.8	2.2						
bouncy	3	1	1			5.5	1.9										
brassy	0	1	2	2.1	2.2			−2.3	3.3							2.2	2.2
brick*	1	2	18	5.8	1.3			1.7	2.3	3.1	2.6					5.3	1.8
bristly	1	2	0	2.6	2.7			4.4	1.6								
brittle	3	11	0	0.8	4.5												
broad	2	1	84									2.8	2.2				
broken	6	1	63					3.1	2.4								
bubbly	1	2	1	−3.5	2.6			−3.3	2.4								
bulky	1	1	9									1.9	2.2	3.4	1.8		
bumpy	17	54	0					3.3	2.3								
burning	3	7	50											6.6	0.9		
callused	1	0	0					4.2	2.0								
canvas*	1	1	19	−1.4	2.4			−0.3	3.2							−0.8	2.2
ceramic	1	1	9	2.8	2.8			−2.5	3.1								
chalky	2	5	1	−2.3	2.9			−1.1	2.6								
chilly	2	1	5											−3.6	1.4		
chubby	1	1	2									3.0	2.0			2.0	3.2

APPENDIX (Continued)

Touch-Related Adjective (n = 24)	Sensory List Frequency (n = 120)	Touch-Focused Frequency (n = 120)	K&F Frequency	Hardness, −7 (Soft) to +7 (Hard)		Part Motion,† 0 to +7		Roughness, −7 (Smooth) to +7 (Rough)		Shape,† 0 to +7		Size, −7 (Small) to +7 (Large)		Temperature, −7 (Cold) to +7 (Hot)		Weight, −7 (Light) to +7 (Heavy)	
				M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
chunky	1	1	1									2.6	2.2			1.8	3.3
circular	4	6	21							6.6	1.2						
clammy	4	8	2											0.8	2.1		
clean	7	7	70	−3.3	4.2												
clingy	1	0	0			2.3	1.4										
closed	1	1	106														
cloth*	2	0	43	−2.4	1.9			−2.4	2.9								
coarse	16	51	10	2.7	3.4			5.4	1.5								
coated	1	0	4					−2.8	3.0								
cold	71	112	171											−5.5	1.7		
collapsible	0	1	1			3.5	2.2										
comfortable	10	3	17	−4.8	2.1												
compact	2	1	12									−3.5	2.6				
complete	1	0	181														
concave	1	0	4							5.3	1.4						
conical	1	0	0							5.9	1.6						
contoured	0	1	0							2.8	2.1						
convex	1	0	1							5.2	2.0						
cool	4	18	62											−2.8	2.1		
corroded	1	0	0					3.5	2.4								
cotton*	1	0	38	−4.1	2.2			−3.7	2.7							−4.3	2.5
cracked	3	3	17					3.5	2.0	3.6	2.5						
craterous	1	1	0	2.8	2.6			3.6	1.9	3.6	2.5						
creamy	3	1	1	−4.8	2.4			−4.8	2.1								
creased	1	1	2							2.8	2.5						
crevices*	1	1	1					3.9	1.7								
crinkled	1	1	0	0.3	2.5			2.4	2.4			1.8	1.9				
crinkly	2	1	0	0.8	2.7			2.7	2.2			1.9	2.0				
crisp	2	2	8	1.8	3.1			2.0	3.5								
crumpled	2	1	3					3.1	2.6								
crumbly	1	1	1	−0.5	3.4			3.2	2.3								
crushed	1	1	10	1.0	2.8												
crusty	1	2	0	2.6	2.2			2.9	2.4								
cubical	4	5	0							6.3	1.2						
cuddly	8	6	0	−5.0	1.7												
curly	5	2	5							4.2	2.2						
curved	3	11	7							4.3	2.3						
cushioned	1	2	0	−3.8	1.9												
cushiony	1	1	0	−4.3	2.1												
cushy	2	2	0	−4.7	1.7												
cylindrical	3	4	11							6.2	1.4						
damp	5	13	16											−0.3	1.8		
delicate	3	5	27	−4.2	2.6												
dense	4	3	9													4.4	1.8
dented	1	2	1					2.4	2.5	3.5	2.3						
dewy	2	2	0											−0.4	1.7		
dimensional	1	1	11							4.3	2.7						
disjointed	0	1	1	1.4	3.0			2.7	2.3								
dusty	2	6	16					−0.8	3.1								
egg−shaped	1	1	0							5.7	2.5						
elastic	2	3	7			2.4	2.3										
empty	1	2	64													−4.3	2.5
enormous	2	1	17									6.7	0.5				
etched	1	2	2					2.8	2.6								
fabric*	0	1	15	−2.8	1.8			−1.9	2.5								
fat	14	14	60									5.1	1.5			5.2	1.7
feathered	3	1	4	−4.8	1.8			−4.6	2.0							−5.8	1.1
felt*	1	1	357	−3.6	2.6			−3.9	2.2								
fiberglass*	1	0	5	3.3	2.2			2.7	4.4								
fibrous	0	1	5					2.3	2.5								
filmy	0	1	11	−2.8	2.3												
fine	3	4	161					−5.2	2.1								
firm	7	13	107					4.2	1.6								
flabby	1	2	0	−2.8	2.1											1.4	2.9
flaky	1	4	2			2.7	2.3										

APPENDIX (Continued)

Touch-Related Adjective (n = 24)	Sensory List Frequency (n = 120)	Touch-Focused Frequency (n = 120)	K&F Frequency	Hardness, −7 (Soft) to +7 (Hard)		Part Motion,† 0 to +7		Roughness, −7 (Smooth) to +7 (Rough)		Shape,† 0 to +7		Size, −7 (Small) to +7 (Large)		Temperature, −7 (Cold) to +7 (Hot)		Weight, −7 (Light) to +7 (Heavy)	
				M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
flannel*	1	0	4	−3.5	1.7			−2.9	2.8								
flat	24	22	67					−2.7	4.1	3.3	2.9						
flexible	5	10	25			3.9	2.4										
flimsy	5	3	2	−2.7	1.7											−3.8	1.5
floppy	1	1	1			4.2	2.0										
fluffy	17	19	1	−5.9	1.4											−5.3	1.9
fluid*	1	1	21	−4.8	2.7	3.8	3.2	−4.6	2.5								
foamy	1	3	3	−4.4	1.9												
foldable	1	0	0			3.7	2.1										
formica*	1	0	0	3.1	2.5			−1.3	4.1								
fragile	1	5	10													−2.8	2.4
frayed	1	4	3					−0.8	2.4	1.7	1.9						
freezing	6	14	15											−6.7	0.8		
frigid	1	2	5											−6.2	1.4		
fringy	1	0	0							1.7	2.1						
frizzy	1	2	0					0.6	4.1								
frosty	2	1	1											−5.8	1.2		
frozen	1	4	27											−6.7	0.7		
full	2	24	230													3.6	2.0
furry	24	37	0	−5.3	1.7			−2.8	2.9								
fuzzy	26	40	7	−4.0	2.1			−1.6	3.8								
gelatinous	1	5	0	−4.3	2.8	1.6	2.2	−4.2	2.6								
gigantic	4	2	10									6.8	0.5				
glass*	1	0	99	2.4	3.3			−5.2	1.9								
glassy	2	7	2	2.3	3.3			−4.3	2.9								
gluey	1	1	0					−2.9	0.0								
gnarled	1	1	1					4.4	1.7								
gooey	2	14	1	−4.3	1.9			−4.9	1.6								
goopy	0	1	0	−4.3	2.1			−3.6	2.4								
grainy	9	14	0	1.8	3.0			3.9	2.0								
granular	0	1	3					3.5	2.6								
gravelly	1	1	7					4.1	2.6								
greasy	6	12	8					−5.1	2.2								
grimy	1	1	0					−1.2	4.1								
grippy	1	0	0														
grooved	3	4	1					1.7	2.4								
hairy	22	44	5	−1.4	2.5			0.0	3.5								
hand−sized	1	0	0									−2.3	2.5				
hard	91	107	202	6.3	1.1												
harsh	1	2	12					5.5	1.5								
heat*	0	1	97											5.6	1.6		
heavy	30	34	110													6.9	0.3
holey	2	6	0					2.0	2.6								
hollow	4	5	12													−4.2	1.8
hot	66	100	130											6.5	0.7		
huge	6	1	54									5.4	1.6				
humid	1	1	1											3.3	1.7		
hurt	1	2	37											1.8	4.0		
icky	1	1	0											−0.3	3.2		
icy	3	4	12	4.8	1.9			−4.3	3.8					−5.6	1.7		
immense	1	1	14									5.8	1.7				
indestructible	1	1	1	6.4	0.7												
inflexible	1	1	3	4.9	1.9												
insulated	1	0	4											1.8	2.6		
intricate	3	1	10									−2.2	4.1				
jagged	2	14	5					6.3	1.0	4.0	2.7						
knitted	1	3	8	−3.2	1.7												
knobby	2	3	0	1.8	3.0			2.6	2.0								
lacy	1	2	4	−2.5	2.0			−1.4	3.6								
large	14	17	361									5.0	1.6				
leather*	5	4	24	−0.9	2.7			−2.1	3.1								
level	0	1	213														
light	29	33	333													−6.5	1.2
limp	1	0	12	−3.3	2.5												
little	6	5	831									−4.6	2.1				

APPENDIX (Continued)

Touch-Related Adjective (n = 24)	Sensory List Frequency (n = 120)	Touch-Focused Frequency (n = 120)	K&F Frequency	Hardness, −7 (Soft) to +7 (Hard) M	SD	Part Motion,† 0 to +7 M	SD	Roughness, −7 (Smooth) to +7 (Rough) M	SD	Shape,† 0 to +7 M	SD	Size, −7 (Small) to +7 (Large) M	SD	Temperature, −7 (Cold) to +7 (Hot) M	SD	Weight, −7 (Light) to +7 (Heavy) M	SD
lopsided	1	1	0							3.9	2.3						
lubricated	1	0	1			2.7	2.7	−6.2	0.9								
lukewarm	3	8	5											1.8	1.8		
lumpy	4	10	2					2.9	2.5								
matted	1	1	0					0.3	3.1								
maxi	1	0	0									4.0	3.7				
melted	1	1	9	−3.2	2.6									1.9	2.2		
metal*	5	8	61	5.2	1.9												
metallic	5	7	9	2.8	2.9			−1.9	3.7								
microscopic	2	1	8									−7.0	0.0				
mini	1	0	0									−5.5	1.0				
minuscule	2	1	1									6.8	0.4				
minute	1	1	53									−4.9	2.2				
moveable	2	3	19			4.7	2.3										
muscular	3	2	16	3.1	3.7												
mushy	4	8	0	−5.3	1.5												
narrow	7	3	63									−3.0	2.1				
nonbreakable	1	1	0	5.3	2.0												
nonsymmetrical	0	1	0							2.9	2.5						
nylon*	1	1	1	−2.7	1.7			−2.6	2.5								
obese	1	0	0									5.9	1.2				
oblique	1	1	1							4.3	2.7						
oblong	4	6	1							5.3	1.9						
octagonal	0	1	3							6.9	0.3						
odd−shaped	1	1	0							4.3	2.5						
oily	4	10	10					−6.2	0.7								
open	0	3	319			3.9	2.7										
oval	1	3	8									6.3	1.8				
oversized	1	0	2											5.3	1.1		
painted	1	1	40					−3.0	2.5								
papery	1	1	1					−3.2	2.6							−1.4	2.3
parallel	1	1	40							4.3	1.9						
pebbly	1	2	0	3.3	2.1			3.8	2.5								
peeling	1	1	6					0.8	3.0								
perforated	1	1	3					0.4	3.1								
perpendicular	2	2	2									4.3	1.8				
petite	1	1	1											−4.3	2.2		
pint−sized	2	0	1							2.4	2.9						
plastic*	9	9	31					−4.1	2.5								
pliable	4	11	1														
plush	3	9	3	−5.1	1.7												
pointed	4	13	74							4.8	1.9						
pointy	8	9	0	3.2	2.2					3.7	2.6						
polished	1	1	14					−5.3	1.8								
powder*	2	2	28	−4.3	2.4			−4.3	2.5								
prickly	4	36	2	3.6	2.1			5.2	1.6								
puffy	1	3	2	−5.3	1.4												
pulsating	1	0	3			5.5	1.3										
pulsing	1	1	2			5.7	1.3										
pyramidal	1	0	1							6.5	0.8						
ragged	0	1	9					3.3	2.9								
rectangular	8	9	5							6.3	1.2						
ribbed	3	5	0					3.4	1.8	3.2	2.7						
ridged	3	7	0					3.1	2.4								
rigid	2	16	24	4.9	1.7												
rippled	1	1	1					3.1	2.5								
rocky	0	5	10	4.4	2.2			4.8	2.2								
rolled	1	1	47									2.7	2.3				
room temperature	1	1	0											1.4	1.7		
rotund	1	0	1									3.6	2.4				
rough	65	94	41					6.2	1.6								
round	35	57	81							5.6	2.2						
rubbery	9	21	1	−2.0	2.8												
rugged	1	2	19					4.0	2.0								
rust*	3	2	10					3.5	2.4								

APPENDIX (Continued)

Touch-Related Adjective (n = 24)	Sensory List Frequency (n = 120)	Touch-Focused Frequency (n = 120)	K&F Frequency	Hardness, −7 (Soft) to +7 (Hard)		Part Motion,† 0 to +7		Roughness, −7 (Smooth) to +7 (Rough)		Shape,† 0 to +7		Size, −7 (Small) to +7 (Large)		Temperature, −7 (Cold) to +7 (Hot)		Weight, −7 (Light) to +7 (Heavy)	
				M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
sandy	3	7	6					3.9	2.7								
satiny	1	7	0	−5.0	1.9			−5.3	1.5								
scalding	3	2	1											6.9	0.3		
scaly	4	10	0					1.9	4.2								
scorching	1	1	0											7.0	0.0		
scratchy	11	20	1					5.0	1.9								
scrunchy	1	1	0					0.6	3.1								
sequined	1	0	0					3.3	2.2								
serrated	1	2	0					4.0	2.7								
shape*	1	0	85							4.5	3.1						
shapely	1	0	2							4.7	2.1						
sharp	33	71	72	3.4	3.6												
shiny	1	1	3					−4.2	2.5								
short	12	14	212									−3.4	2.1				
silky	15	38	1	−5.7	1.9			−5.9	1.6								
skinny	9	8	9									−3.4	2.0				
slanted	2	1	3							2.8	1.9						
sleek	1	1	2					−4.6	2.7								
slender	1	2	19									−3.3	2.2				
slick	9	18	7					−5.5	1.7								
slim	3	0	20									−3.3	2.1				
slimy	15	37	0					−5.2	2.2								
slippery	10	25	5					−6.2	0.7								
slushy	1	1	0											−4.0	1.5		
small	16	31	542									−5.4	1.7				
smooshy	1	3	0	−5.1	1.3												
smooth	77	106	42					−6.9	0.3								
soft	104	111	61	−6.3	1.7												
soggy	1	1	3	−4.3	1.5												
solid	11	13	77	5.9	1.6												
spherical	5	7	8							6.3	1.5						
spiky	3	5	0	3.8	2.2			5.8	1.7								
splintery	0	3	1							1.8	2.4						
spongy	2	8	2	−3.7	1.6												
square	24	36	143							6.5	1.2						
squeezable	0	4	0	−3.8	1.7												
squishy	20	28	0	−4.6	1.9												
starched	1	1	2	1.3	2.8												
steamy	1	1	0											4.3	1.6		
steel*	1	1	45	5.3	1.7											5.2	1.9
stiff	7	6	21	4.9	2.0												
straight	5	13	114							4.3	2.4						
stretchy	2	1	0			3.8	1.8										
stubbly	1	2	0	1.8	3.6			5.0	1.2								
sturdy	8	6	16														
suede*	0	3	0	−3.3	2.6			−3.6	2.9								
sweaty	5	7	5											3.4	1.4		
swollen	0	1	12							1.8	2.1						
symmetrical	2	5	2							3.2	2.3						
tall	7	6	55									3.3	1.7				
temperate	0	2	2											0.9	1.7		
tender	4	5	11	−5.0	2.0												
tetrahedral	0	1	0							6.5	1.4						
textured	1	16	2					0.8	3.6								
thick	11	17	37									2.8	2.0				
thin	14	31	92									−2.8	2.4				
thorny	0	3	2					5.8	1.9	3.5	2.7						
tight	6	10	28			0.9	1.9										
tin*	1	1	12	2.3	2.1			−1.8	3.0								
tiny	8	8	50									−5.8	1.6				
top heavy	1	1	1													3.9	2.2
tough	3	3	36	4.7	2.3												
triangular	11	16	5							6.4	1.0						
tubular	1	2	4							5.8	1.8						
twisted	2	3	19			3.5	1.6										

APPENDIX (Continued)

Touch-Related Adjective (n = 24)	Sensory List Frequency (n = 120)	Touch-Focused Frequency (n = 120)	K&F Frequency	Hardness, −7 (Soft) to +7 (Hard)		Part Motion,† 0 to +7		Roughness, −7 (Smooth) to +7 (Rough)		Shape,† 0 to +7		Size, −7 (Small) to +7 (Large)		Temperature, −7 (Cold) to +7 (Hot)		Weight, −7 (Light) to +7 (Heavy)	
				M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
varnished	0	1	0					−3.7	2.5								
velour*	1	1	1	−3.8	2.1												
velvety	5	12	3	−5.3	1.6			−5.3	1.6								
vibrating	1	1	1			5.4	1.6										
wafflish	1	1	0					1.6	2.5								
warm	39	78	67											2.8	1.5		
waxy	0	4	2					−3.6	2.2								
whole	2	1	309							2.1	2.8						
wiggling	1	1	2			5.5	1.5										
windy	2	0	2			4.8	2.3										
wiry	1	0	8							3.3	2.2						
wobbly	2	3	2			4.8	1.9										
wooden	5	8	50	3.8	2.2			1.3	2.8								
woolly	3	3	3	−1.5	2.7			0.0	4.2								
woven	0	2	9					−0.2	4.5								
zippered	1	0	0			2.4	1.8										

Note—K&F, Kučera & Francis (1967) frequency in written English per million words.   *Indicates a noun.   †Readers are advised to use shape and part motion rankings with caution.