Chapter 6

The Phonology of Russian Liquids

Russian is a language of particular interest in the study of liquids because its consonantal phonology is distinguished by two major characteristics: contrastive palatalization, and typologically unusual phonotactics.

Because the contrast between palatalized and non-palatalized phonemes affects all types of consonant in Russian, the first question to be considered is whether or not liquids differ from obstruents in terms of their gestural constituency. Specifically, it has been claimed that Russian non-palatalized consonants are inherently velarized (Trubetzkoy 1969, Cubberley 2002). If so, we would expect to find evidence for a dorsal gestural component in all non-palatalized consonants, including obstruents. In Chapter 1, it was proposed that the class of liquids might be characterized by a shared dorsal gesture, which raises the question of whether liquids differ articulatorily from the other non-palatalized consonants of Russian, and if so, how? Additionally, we need to consider the extent to which palatalized liquids pattern with the other liquids of Russian, and the way in which they might be represented in the articulatory model proposed in Chapter 5.

Another important issue in Russian liquid phonology is the way in which the sonorants feature in some typologically irregular phonotactic distributions. Russian words, for example, can begin with a sonorant followed by an obstruent (лгать [lgatʲ] *'to lie'*, рдеть [rdetʲ] *'to glow'*, мстить [mstʲitʲ] *'to revenge'*), an onset structure which is typically prohibited in most languages. The case was made in Chapter 2 that one of the essential properties of liquids is their tendency to appear closer to the nucleus in consonant clusters; therefore any treatment of the phonology of Russian liquids must address this phenomenon, and offer some account of their distribution in clusters.

In this chapter, a brief survey of Russian consonantal phonology will be presented.

Evidence for the class of liquids in Russian will be considered. Previous phonetic studies of Russian liquids will be reviewed, and the phonetic characterization of the class will be discussed. Finally, the goals of a phonetic study of Russian liquids will be set out, before these experiments are presented in Chapter 7.

6.1 Russian Consonantal Phonology

Russian uses 33 consonants, and a system of five vowels which are realized as a rich set of allophones governed by stress and phonological enviroment. Each Russian word bears one lexically specified stressed syllable, and non-stressed vowels are reduced (Timberlake 2004). The phonemic inventory of Contemporary Standard Russian (CSR) is illustrated in Table 6.1. Although Cubberley (2002) and Timberlake (2004) classify all coronal consonants as dental, considerable variation can be seen in their realization between dental and alveolar places of articulation (Fant 1960, Bolla 1981).

TABLE 6.1: **Phonemic inventory of Contemporary Standard Russian** (adapted from Jones & Ward 1969). [a]

	LAB	LDENT	DENT	ALV	PALV	PAL	VEL	
Stop	p, b		t, d				k, g	
	p^j,b^j		t^j,d^j				k^j	
Affricate			ts					
				tʃ				
Fricative		f, v		s, z	ʃ, ʒ		x	
		f^j,v^j		s^j,z^j				
Nasal	m		n					
	m^j		n^j					
Rhotic				r				
				r^j				
Lateral			l					
			l^j					
Glide						j		
Vowel						i		u
						e		o
							a	

[a] The marginal phonemes /$ʃ^j$/, /g^j/ and /x^j/ have not been included in this inventory. See Timberlake (2004) for treatment of their phonemic status.

6.1.1 Contrastive Palatalization in Russian

A characteristic feature of Russian consonantal phonology is that most sounds have both a palatalized ('soft') and a non-palatalized ('hard') form, each of which is considered to be a distinct phoneme (Timberlake 2004). Palatalization is contrastive in word-final and heterorganic medial coda positions. Except in historical loan words, non-palatalized consonants do not generally occur before /e/ (Padgett 2003). Palatalization is contrastive before the high front vowel /i/, which is realized as its high central allophone [ɨ] after non-palatalized consonants to facilitate the distinction.[1] The contrast between palatalized and non-palatalized coronal obstruents is neutralized to non-palatalized in homorganic medial clusters, e.g. путь [putʲ] *'way'* → путьниj ['putnɨj] *'approximate'* (Kochetov 2006).

The difference between these 'mutable pairs' of consonants is typically described as one of secondary articulation (Jones & Ward 1969, Catford 1988, Ladefoged & Maddieson 1996). It is not only the palatalized consonants which are considered to involve a secondary articulation; the 'plain' consonants are commonly described as velarized (Reformatskii 1958, Öhman 1966, Trubetzkoy 1969), yet the evidence for this claim is unclear.

Russian non-palatalized consonants have been described as velarized on purely perceptual grounds, to account for their characteristically 'dark' or 'hard' qualities, which contrast with the 'light', 'soft' or 'sharped' nature of their palatalized equivalents (Halle 1959; Cubberley 2002). The characterization of Russian consonants as occurring in palatalized/velarized pairs has also been made through analogy with other languages which feature similar phonological contrasts, such as Marshallese (Bender 1969), Irish (Ní Chiosáin 1991) and Arabic (Catford 1988). It has also been proposed that Russian non-palatalized consonants might be velarized because the realizations Cʲ and Cˠ represent an optimal solution to the problem of maximizing contrast between two underlyingly similar consonants, for example in Dispersion Theory (Padgett 2003), or in a phonological system predicated on relationships of "proportional opposition" (Trubetzkoy 1969).

The Phonetic Realization of Contrastive Palatalization

Kavitskaya (2006) has demonstrated, used gating experiments, that "cues for palatalization are at least as perceptually salient for the speakers of Russian as cues for voicing or place of articulation", which raises the question of how such a phono-

[1] The phonemic status of the vowel [ɨ] is still a matter of some debate. The existence of the minimal pair ыкать [ɨkatʲ] *'to say ɨ'*/икать [ikatʲ] *'to say i'*, for example, has been used to argue for the phonemic independence of the two high non-back vowels in Russian (Leed 1963).

logically robust contrast is implemented phonetically. Kochetov (2006) argues that plain and palatalized consonants are phonetically distinguished in Russian by two types of acoustic cue: primarily by their effect on the formant transitions of adjacent vowels, but also in the qualities of their release bursts.

Russian palatalized consonants are generally characterized by the presence of a raised second formant, and also some raising of the higher formants, in adjacent vowels (Halle 1959, Jakobson et al. 1963, Fant 1960). Non-palatalized (coronal) consonants, in contrast, are typically characterized by a lowered F2 and a raised F1 (Fant 2004). Similar differences between palatalized and non-palatalized consonants have been observed in other studies of Russian and other languages, which suggests that F2 transitions – rising in VC sequences and falling in CV sequences – provide a robust phonetic cue to palatization (Bondarko 1977, Purcell 1979, Padgett 2001). In high front vowel contexts palatalization appears to be cued by zero F2 transitions (Halle 1959), while plain consonants result in a falling F2, although the distinction appears to be less salient than in other vocalic environments (Jones & Ward 1969, Kochetov 2006).

Although we have a reasonable understanding of the acoustic manifestation of the Russian palatalization contrast, the articulatory basis of this distinction is not well understood. Partly due to a lack of articulatory data, many assumptions have been made about the production of Russian non-palatalized consonants, or hypotheses drawn about their articulatory characterization, based on the results of acoustic studies. A fundamental problem with this approach is that these hypotheses assume a more straightforward relationship between the acoustic properties of the speech signal and the underlying articulation than is necessarily the case. For example, based on area functions derived from X-ray images, Fant (1960) predicted a 530 Hz difference between the second formant loci of plain and palatalized coronal stops, but both he and Bondarko (1977) observed a much smaller difference in their acoustic measurements of F2 in a low vowel context (Kochetov 2006).

Fant (2004) has proposed that the formant trajectories associated with Russian non-palatalized (coronal) consonants (lowered F2, raised F1) result from the approximation of the back of the tongue to the back wall of the pharynx, and has therefore characterised these consonants as velarized. Padgett (2001) concluded that Russian (but not Irish) non-palatalized consonants are velarized by comparing the F2 trajectories of consonants produced by three speakers of Russian and Irish. Yet Ladefoged & Maddieson (1996) conclude from spectral and X-ray analysis that only in Marshallese are the non-palatalized consonants systematically velarized, and propose that only the non-palatalized lateral should be classified as velarized in Russian.

Midsagittal images of Russian consonant articulation captured in X-ray studies by Skalozub (1963) and Bolla (1981) do not show non-palatalized consonants other than the lateral to be consistently produced with a distinctively retracted or raised dorsum, which supports the conclusions of Ladefoged & Maddieson. However, because neither of these studies examined dynamic articulation in multiple vowel contexts by multiple speakers, we are not able to make strong claims about the gestural characterization of the non-palatalized consonants based on this limited data.

Kedrova et al. (2008) used MRI to examine the articulation of hard and soft consonant pairs in four speakers of Russian. They concluded that "while position and form of the tongue shape and body characteristic for every hard consonant highly depend on its role in the entire sound system of the language associated with a certain bundle of distinctive features, all soft consonants seem to be produced with a roughly similar articulatory pattern." However, the authors did not attempt to quantify the articulatory differences which they observed, and only illustrate contrasts for one speaker in the [a_a] context, so it is difficult to know what to conclude from their study.

In summary, although the acoustic properties of Russian consonants have been well described, we do not have a clear idea of the way in which mutable consonant pairs are contrastively articulated. In particular, the articulatory characterization of Russian non-palatalized consonants is not well understood – to what extent these consonants are consistently and contrastively velarized, and if so, what the precise dorsal gestural target is. This is an issue which must be addresed in a phonetic study of Russian liquids, since we will not be able to describe their goals of production without also understanding the ways in which other pairs of consonants are contrastively articulated in Russian.

6.2 Russian Liquids

There are four liquid consonants in Russian: two trills /r/ and /rʲ/, and two laterals /l/ and /lʲ/. All four liquids are contrastive in word-initial, intervocalic, heterorganic medial coda and word-final environments (subject to the same constraints before front vowels as the other consonants). Examples of each of these contrasts are given in Table 6.2.

ENVIRONMENT	EXAMPLE	IPA	GLOSS
Word-Initial	рука	/ru'ka/	*'hand'*
	рюкзак	/'rʲukzak/	*'rucksack'*
	лук	/luk/	*'onion'*
	люк	/lʲuk/	*'hatch'*
Medial Onset	парад	/pa'rat/	*'parade'*
	наряд	/na'rʲat/	*'costume'*
	палата	/pa'lata/	*'chamber'*
	палят	/pa'lʲat/	*'they scorch'*
Medial Coda	горка	/'gorka/	*'hill'*
	горько	/'gorʲko/	*'bitterly'*
	полка	/'polka/	*'shelf'*
	полька	/'polʲka/	*'polka'*
Word-Final	удар	/u'dar/	*'blow'*
	ударь	/u'darʲ/	*'hit*-IMP*'*
	дал	/dal/	*'gave'*
	даль	/dalʲ/	*'expanse'*

TABLE 6.2: **Liquid contrasts in Russian**

6.3 Evidence for the Class of Liquids

There are two main sources of evidence for the existence of a class of liquids in Russian. The liquids pattern together in phonological processes in ways that suggest they form a subclass of the sonorants. However, as in many other languages, the primary evidence for a class of liquids in Russian is their shared phonotactic distribution within the syllable.

6.3.1 Phonotactics of the Russian Syllable

A characteristic feature of Russian phonology is the wide range of consonant clusters which it uses. From a typological perspective, these clusters are noteworthy for their length and unusual phonotactics. Russian allows longer clusters than most languages – up to four consonants in both onsets (вскрыл ['fskrɨl] *'he opened'*) and codas (чёрств [tʃorstf] *'stale'*). Most remarkably, it tolerates sonorant-obstruent combinations which violate the Sonority Sequencing Principle (SSP: Sievers 1881; Kiparsky 1979), both word-initially (ртуть [r̪tutʲ] *'mercury'*) and word-finally (жезл [ʒez̪l] *'staff'*).

The existence of these words would seem to suggest that Russian phonological

structure is not subject to the same principles of syllable-level organization which generally apply in languages which allow complex onsets and codas. However, a closer examination of the origins of SSP-violations, their distribution, and the morphophonological behavior of the words which contain them, reveals that Russian phonology is generally sensitive to a sonority hierarchy in which the liquids play an important role as a subclass of the sonorants. Because these phenomena can only be understood in a historical context, the diachronic development of Russian syllable structure will briefly be described, before the role of liquids in the phonotactics of the modern language is examined more carefully.

Historical Origins of Russian Consonant Clusters

The rich set of consonant clusters found in modern Russian arose from a series of phonological developments which occurred as the language emerged from Late Common Slavic (LCS). Common Slavic originally featured two high, lax vowels ь and ъ, which have been reconstructed as */ɪ/ and */ʊ/ respectively (Carlton 1991). In LCS, the jer vowels developed into weak and strong allophones, determined by their position in a word: the right-most jer becoming weak, the penultimate jer strong, continuing leftwards in an alternating pattern of weak and strong vowels (Havlík 1889, Carlton 1991). The eventual outcome of this process in the East Slavic languages was that all weak jers were deleted ('the fall of the jers'), and strong jers were strengthened ('the vocalization of the jers').

Two important outcomes of these developments in Russian were the emergence of contrastive palatalization (Padgett 2003), and the change from a canonical CV syllable structure to more complex phonotactics (Pugh 2007). The loss of jers in word-final and other positions resulted in closed syllables, and produced many monosyllabic words from earlier multisyllabic forms ([dʲenʲ] < *дьнь [dɪnɪ] *'day'*). In both onsets and codas, a number of previously unattested consonant clusters arose through widespread syncope of intervening vowels. Most remarkable of these new clusters were those sonorant-obstruent combinations in which the ordering of consonants was in violation of the SSP (Table 6.3; examples taken from Carlton 1991; Yearley 1995; Wade 1996).

Although many more examples of sonority reversals can be found in the lexicon, on the whole, these forms can be seen as historical anomalies which do not reflect syllable structure preferences in Modern Russian. Two types of evidence indicate that this is the case. Most importantly, the words which contain these problematic clusters are much rarer than words in which consonant sequencing conforms to the sonority hierarchy. Secondly, a variety of repair strategies which seek to avoid these SSP-violations can be observed in both diachronic and synchonic phonologi-

C.SLAVONIC	RUSSIAN	GLOSS
*/rɪtotɪ/	/r̂tutʲ/	*'mercury'*
*/rɪdiaː/	/r̂ʒa/	*'rust'*
*/lɪbɪ/	/l̂ba/	*'forehead-gen.sg'*
*/lɪgamu/	/l̂gatʲ/	*'to lie'*
*/lɪstɪtʃɪ/	/l̂ʲstʲets/	*'flatterer'*
*/bobrɪ/	/b̂obr̂/	*'beaver'*
*/ʃɪdlʊ/	/ʒ̂ezl̂/	*'baton'*

TABLE 6.3: **Russian 'reverse sonority' clusters** arising from jer deletion.

cal processes in Russian.

Sonority Sequencing in Russian Syllable Structure

Yearley (1995) observes that most sonority sequencing violations in Russian clusters occur at word boundaries. Medial tautosyllabic clusters, on the other hand, tend to avoid the sonority plateaus and reversals which can be found in peripheral clusters. Word-medial syllable onsets, for example, typically consist of an obstruent-sonorant sequence, e.g. [po.smer.tno] *'posthumously'*, [u.po.tre.blʲatʲ] *'to use'*. Word-medially then, Russian liquids (along with the nasals) perform the same role in syllabic organization as they do in other languages with complex onsets – acting as cluster-enabling consonants, located closer to the nucleus than the less sonorant consonants with which they combine.

In order to examine SSP-violations in more detail, a corpus analysis was conducted to determine which consonant combinations are found in Modern Russian word-peripheral clusters, and their frequencies of occurence. Three corpora were used: a list of the 10,000 most frequent words of Russian compiled by Brown (1996); the Uppsala corpus of 1 million words of written Russian (Lönngren 1993); and a list of all words with a frequency of occurence greater than one instance per million words, compiled by Sharoff (2002, 2008) from a composite corpus of 16.3 million words of written Russian.

Amongst the 10,000 most frequent words of Russian listed by Brown, 451 /r/-initial words were found; only six of these (1.3%) begin clusters, and none have a frequency ranking greater than 3327rd (рвать [rvatʲ] *'to tear'*). There are no /rʲ/-initial clusters in the corpus, although 101 words begin with the palatalized rhotic. Two lateral-initial clusters can be found in 71 /l/-initial words (лгать [lgatʲ] *'to lie'* (3725th), лживый [lʒɨvɨj] *'mendacious'* (6571st)), and only three /lʲ/-initial clusters,

all of which are very low frequency (льгота [lʲgota] *'privilege'* (9272nd), льдина [lʲdʲina] *'block of ice'* (9273rd), льстить [lʲstʲitʲ] *'to flattter'* (9824th)).

Trapman (2007) notes that sonority-violating clusters were also found to occur with low frequencies in both onsets and codas in the million-word Uppsala corpus. Lexical frequency analysis of the same corpus reveals that SSP-complient onset clusters, in contrast, are ubiquitous word-initially, and that many of the most frequent words of Russian begin with obstruent-liquid clusters: для [dlʲa] *'for'* (41st most frequent), другой [drugoj] *'different, other'* (47th), слово [slovo] *'word'* (86th), глаз [glaz] *'eye'* (87th), спросить [sprositʲ] *'ask'* (108th), etc. (frequencies taken from Brown 1996).

We can gain further insights into the phonotactic preferences of Russian consonant clusters by examining even larger corpora. The frequencies of all word-peripheral obstruent-liquid and liquid-obstruent clusters found in Sharoff's 69,307 word list are listed in Fig. 6.1. The corpus was digitized to allow for automatic analysis, and Perl scripts were written to compile phonotactic statistics. Each line indicates the number of times each obstruent appeared adjacent to a liquid in word-initial and word-final clusters in the corpus. For example, 4402 words were found to begin with the cluster /pr-/, and 414 words were /pl-/-initial, but no words in the corpus begin with the combinations /rp-/ or /lp-/.[2]

Onsets	$C^{(j)}r^{(j)}$-	$r^{(j)}C^{(j)}$-	$C^{(j)}l^{(j)}$-	$l^{(j)}C^{(j)}$-
p	4402	0	414	0
b	321	0	280	5
t	626	0	3	0
d	208	0	42	8
k	678	0	262	0
g	501	0	226	8
ʦ	0	0	0	0
ʧ	18	0	8	0
f	74	0	40	0
v	154	49	134	5
s	118	0	531	2
z	35	0	75	0
ʃ	5	0	55	0
ʒ	13	18	2	6
x	142	0	80	0
	7295	**67**	**2152**	**34**

Codas	$-C^{(j)}r^{(j)}$	$-r^{(j)}C^{(j)}$	$-C^{(j)}l^{(j)}$	$-l^{(j)}C^{(j)}$
p	1	1	1	1
b	2	5	8	2
t	27	38	0	8
d	9	14	0	1
k	2	10	3	9
g	4	10	0	1
ʦ	0	1	0	0
ʧ	0	2	0	0
f	3	3	0	2
v	3	3	1	1
s	0	7	3	4
z	0	1	1	14
ʃ	0	3	0	1
ʒ	0	1	0	0
x	2	6	0	0
	53	**105**	**17**	**44**

FIGURE 6.1: Frequencies of occurence of **obstruent-liquid and liquid-obstruent onset and coda clusters** in Sharoff's (2008) corpus of most frequent words in Contemporary Standard Russian.

Based on the data summarized in Fig. 6.1, we can estimate that only 1.06% of Russian onset clusters feature sonority violations. Rhotic onset clusters are particularly

[2] In order to simplify the phonotactic analysis, palatalized/non-palatalized consonant pairs were not distinguished when compiling obstruent-liquid clustering frequencies in Fig. 6.1.

averse to SSP violations – no rhotic-stop onsets were found in the corpus, and all anomalous rhotic-initial clusters involved one of the two fricatives /v/ and /ʒ/. Sonority reversals are rather more prevalent in codas; nevertheless, coda clusters which include a liquid still show a strong preference to be obstruent-final (70.7%).

The conclusion to be drawn from the corpus analysis is that even in word-peripheral clusters, SSP-violations are relatively rare in Russian: there are many fewer words which contain these reverse-sonority clusters, and those words which do are less frequently used in the modern language than words built from SSP-compliant syllables.

In the inflectional morphophonology of Modern Russian, sonority-sequencing violations are often avoided where they would have otherwise arisen, through the use of repair strategies such as epenthesis and deletion. Pugh (2007) observes that epenthetic vowels have appeared in some words where there was no original jer, in order to avoid inherited liquid-final clusters (/sestër/ *'sister-gen.pl'* < /sestrá/). In the verbal inflectional system, the masculine singular past tense marker /-l/ never attaches directly to a consonant-final stem (e.g. ВЕСТ- [vest-] *'drive, lead'*): either the stem-final consonant deletes ([vʲel] *'drove'*-M.SG.DEF.IMPF), or an vowel-final or epenthetic allomorph is used ([vodʲil] *'drove'*-M.SG.INDEF.IMPF) to avoid the infelicitous cluster. Allomorphy of this type suggests that liquid-obstruent clusters which violate the sonority sequencing principle are generally dispreferred in Russian.

Collectively, these data show that the modern lexicon of Russian demonstrates an overwhelming preference for syllable structures in which onsets, and to a lesser extent also codas, conform to typologically-standard sonority sequencing principles.

The Role of Liquids in Russian Cluster Phonotactics

In many of the phonotactic phenomena described so far, the liquids pattern with the other sonorants in terms of their distribution with respect the obstruents. Additional evidence for the existence of a separate class of liquids may be found when we examine the phonotactics of clusters more closely.

A list of all two-consonant word-initial onset clusters, along with the number of times they are found in the Sharoff (2008) corpus, has been compiled in Fig. 6.2. The data reveal an overwhelming preference for sonorant-final clusters (71.5%), rather than obstruent-obstruent onsets (28.5%). Furthermore, the data show that liquids are the prefered cluster-enabling consonant in Russian word-initial syllable onsets of this complexity: 64.2% of all #CC- clusters are liquid-final, while only 7.2% are nasal-final.

CL-	n	CC-	n	CF-	n	CN-	n
pr	4396	st	878	sv	497	sm	311
kr	678	sp	439	dv	181	sn	177
tr	624	sk	303	zv	140	zn	153
sl	531	stʃ	184	vz	91	vn	121
gr	500	sd	115	vs	88	gn	67
pl	414	ʃt	91	tv	77	mn	57
br	321	sb	81	ps	73	kn	56
bl	280	ʃk	59	xv	60	dn	33
kl	262	zd	54	kv	51	vm	20
gl	225	vp	51	rv	49	xm	17
dr	207	vt	45	tsv	44	ʃn	12
vr	154	vd	34	sʒ	35	zm	11
xr	141	vk	33	sx	32	ʃm	8
sr	118	sg	30	ʃv	31	pn	8
vl	134	pt	26	vv	30	ʒm	6
xl	80	ʃp	26	vx	28	tm	5
fr	73	sts	19	dʒ	21	tʃm	3
zl	75	vtʃ	15	gv	20	xn	1
dl	42	ʒd	13	rʒ	18		
ʃl	35	tstʃ	12	sf	13		
fl	40	ʒg	10	pʃ	7		
zr	35	tʃt	10	lʒ	6		
mr	32	rt	9	sʃ	6		
nr	31	ld	8	lv	5		
ml	19	tk	7	mx	4		
tʃr	18	vb	7	ʃx	4		
ʒr	13	mtʃ	6	vʃ	3		
tʃl	8	lb	5	ʒv	2		
ʃr	5	bd	5	kx	1		
ʒl	2	vts	5	vʒ	1		
tl	3	lg	4	ms	1		
		lg	4	sz	1		
		ptʃ	3	tf	1		
		gd	1	dz	1		
		ʒb	1				
		zt	1				
		xt	1				
		kt	1				
	9496		2596		1622		1066

FIGURE 6.2: **Russian two-consonant word-initial clusters** and frequencies of occurence in Sharoff (2008). Onsets grouped by column into liquid-final, stop-final, fricative-final and nasal-final clusters.

As cluster complexity increases, consonant sequencing in Russian clusters becomes even more constrained, and further asymmetries between liquids and the other sonorants are revealed. Frequencies of occurence of all three-consonant word-initial clusters found in Sharoff (2008) are given in Fig. 6.3. The preference for sonorant-final clusters (75.9%) is even greater in onsets of this complexity, and 95% of all three-consonant sonorant-final clusters end with a liquid (e.g. взрыв [vzrɨv] *'explosion'*), вклад [fklad] *'contribution'*, справка [sprafka] *'information'*).

Russian four-consonant onset clusters are much rarer, but even more highly constrained: all onsets of this length consist of a #FFCL- sequence (e.g. взброс [vzbros] *'upthrust'*, всплеск [fsplesk] *'splash'*). No four-consonant clusters can be formed with a nasal in Russian.

CCL-	n	CCC-	n	CCN-	n
str	391	vsp	62	vzm	17
skr	108	vst	54	mgn	11
spr	105	vzv	36	tkn	6
skl	68	vzd	34	vsm	7
vkl	35	vsk	29	vzn	3
vzr	33	skv	24	sgn	1
spl	21	sdv	20		
vzl	17	stv	12		
zdr	16	vzb	8		
sbr	13	mst	7		
vpr	14	vdv	3		
vgl	9	mzd	1		
vsl	8	vzg	1		
mgl	5	kst	1		
vkr	5				
sbl	4				
vdr	3				
sgl	3				
vpl	3				
vtr	2				
sgr	2				
sdr	2				
smr	2				
stl	2				
vbl	1				
vbr	1				
	873		292		45

FIGURE 6.3: **Russian three-consonant word-initial clusters** and frequencies of occurence in Sharoff (2008). Onsets grouped by column into liquid-, obstruent- and nasal-final clusters.

Further asymmetries between the liquids and the nasals become apparent when we consider sonorant-sonorant clusters in Russian. The frequencies of all nasal-liquid and liquid-nasal clusters found in the Sharoff corpus are tabulated in Fig. 6.4. The data reveal an overwhelming preference for liquid-internal clusters – only three sonority reversals were found amongst the 113 sonorant-sonorant clusters in the corpus. These data provide further evidence that the liquids, by virtue of their clustering properties with respect to nasals, behave as subclass of the Russian sonorants.

Onsets	$N^{(j)}r^{(j)}$-	$r^{(j)}N^{(j)}$-	$N^{(j)}l^{(j)}$-	$l^{(j)}N^{(j)}$-
m	32	0	22	0
n	31	0	0	1
	63	**0**	**22**	**1**

Codas	-$N^{(j)}r^{(j)}$	-$r^{(j)}N^{(j)}$	-$N^{(j)}l^{(j)}$	-$l^{(j)}N^{(j)}$
m	0	14	1	4
n	1	4	0	3
	1	**18**	**1**	**7**

FIGURE 6.4: Frequencies of occurence of **Russian nasal-liquid and liquid-nasal onset and coda clusters** in Sharoff's (2008) corpus of most frequent words in CSR.

6.3.2 Diachronic Processes Involving Liquids

In Section 6.3.1, the syllable-level phonotactics of Russian were examined to demonstrate that the liquids function as a distinct class of sonorants by virtue of their distribution in clusters. Diachronic evidence may also be found for a class of liquids: the rhotics and laterals, uniquely amongst the sonorants, patterned together in a number of historical sound changes which have reflexes in modern Russian. Two of the most important of these sound changes are briefly mentioned here.

Preservation of Liquid-Adjacent Jers

Where jers followed liquids in medial positions, they disappeared completely in Southern Slavic, leaving syllabic liquids. In North Eastern Slavic, jers were preserved and strengthened in the same position, leaving liquid-vowel sequences in Modern Russian (Bethin 1998; Table 6.4).

PROTO-SLAVIC	SOUTH CENTRAL LCS	NORTH EAST LCS
*/kruu̯i/ *'blood'*	Macedonian /kr̩v/	Russian /krovʲ/
*/sliz̆a/ *'tear (n.)'*	Czech /sl̩za/	Russian /slʲeza/

TABLE 6.4: **Development of liquid-jer sequences** in Slavic (Bethin 1998).

Such changes were not restricted to post-liquid vowels – Bethin (ibid.) notes a general trend in which "Russian tended to preserve jers in the vicinity of liquids", which does not hold for the other sonorants. Thus we find Late Common Slavonic *CVL.C sequences preserved in Modern Russian but collapsed into syllabic liquid forms (CV̩C) in their cognates in the Southern languages (Table 6.5, examples taken from Carlton 1990; Bethin 1998).

PROTO-SLAVIC	SOUTH CENTRAL LCS	NORTH EAST LCS
*/pɪrstʊ/ *'finger'*	Serbian /pr̩st/	Russian /pʲerst/
*/vɪlkʊ/ *'wolf'*	Czech /vl̩k/	Russian /volk/
*/gʊrba/ *'hump'*	Macedonian /hr̩b/	Russian /gorb/
*/sɪrpʊ/ *'sickle'*	Slovenian /sr̩p/	Russian /sʲerp/

TABLE 6.5: **Preservation of pre-liquid jers** in North Eastern Slavic.

Liquid Metathesis

Where liquids followed the mid-back vowel in Proto-Slavic sequences of the form *#oLC, many of these sequences have metathesized in the daughter forms found in Modern Russian. This sound change was a process which affected both coda rhotics and laterals (Table 6.6), but not the other sonorants.

PROTO-SLAVIC	RUSSIAN
*/orv-ɪmʊ/ *'even'*	/rov(e)n/-
*/ordlo/ *'plough'*	/ralo/
*/olkotɪ/ *'elbow'*	/lok(o)t/-
*/olk-omʊ/ *'hungry'*	/lakom/-

TABLE 6.6: **Metathesis of vowel-liquid sequences in Russian** (adpated from Cubberley 2002)

6.3.3 Asymmetries between Russian Laterals and Rhotics

In all of the phonological phenomena reviewed so far, both laterals and rhotics participate in the same processes, or share the same distribution; however, there are also some asymmetries within the class of liquids which should be considered.

The Russian palatalized trill depalatalizes before homorganic consonants, while the palatalized lateral does not: e.g. царь [tsarʲ] *'tsar (n)'* but царский [tsarskʲij] *'tsar (adj)'*; c.f. боль [bolʲ] *'pain'* and больнои [bolʲnoj] *'ill'* (Kochetov 2005). Kochetov observes that palatalized rhotics are also more susceptible to depalatalization than palatalized laterals in Irish and Ukranian.

In Russian consonant clusters, palatalized consonants commonly trigger progressive assimilations. However, in some varieties of Russian (e.g. Perm), only the palatalized lateral assimilates preceding non-palatalized coronals, while the palatalized trill does not: /petʲlʲi/ *'loop*-PLU', but /smotrʲit/ *'(he) looks'* (Kochetov 2005).

6.3.4 Summary – The Status of the Class of Liquids in Russian

In this section, phonological and phontactic evidence has been presented to argue for the existence of a class of liquids in Russian. Rhotics and laterals have patterned together in processes including metathesis, and preservation of adjacent vowels.

However, as in many other languages, the primary evidence for a class of liquids in Russian is their shared distribution within the syllable. In complex onsets, and to a lesser extent in complex codas, liquids serve as cluster-enabling segments, typically (and often mandatorily) filling the position closest to the syllable nucleus. Although cases of sonority sequencing violations may be found in Russian, these words have been shown to be historical relics with low frequencies of occurance, which do not reflect the syllable structure preferences of the modern language.

If, as this evidence suggests, the defining characteristic of the class of liquids in Russian is their distribution within the syllable, this raises the question of whether there might be a phonetic basis to the class. Before considering ways in which to test this question experimentally, previous investigations into the phonetics of Russian liquids will briefly be surveyed.

6.4 Phonetic Studies of Russian Liquids

The most comprehensive articulatory study of Russian liquids was conducted by Fant (1960), who used midsagittal X-rays to examine the production of a single set of Russian consonants by a 38 year old male Moscovite. X-ray and palatographic studies of Russian liquids have also been conducted by Matusevich (1976), Skalozub (1963), and Bolla (1981). Kochetov (2005) used Electromagnetic Midsagittal Articulatometry (EMMA; Perkell et al. 1992) to examine word-final liquids produced by three female speakers of Russian speakers.

A basic picture of the essential articulatory characteristics of the four Russian liquids can be gleaned from the collective findings of these studies. The coronal articulation of the laterals appears to be dental-alveolar, while both rhotics are produced with a more retracted coronal contact in the alveolar region. The coronal gesture of each of the non-palatalized liquids is generally reported to be apical, while that of the palatalized liquids appears to be laminal to some extent.

Both palatalized liquids are produced with a central dorsal gesture in these studies: relatively open for the lateral, and a high narrow dorsal approximation in the mid-palatal region in the case of the trill. The non-palatalized lateral was produced with an uvular-pharyngeal/upper pharyngeal approximation of the back of the tongue, while the non-palatalized trill was generally accompanied by a high-back dorsal gesture in the uvular region. For the speaker in Fant's (1960) study, both rhotics appear to have been produced with a more constricted tongue root than the laterals.

Although these studies have provided valuable insights into the articulation of

Russian liquids, each is also limited in some important respects. Other than Kochetov (2005), each of these studies examined the speech of only a single speaker, and in most cases, only one sustained token of each consonant was imaged, produced independently of any context vowel. None of the X-ray studies provide dynamic data about the formation and release of the consonants, and Kochetov does not examine the dynamics of intervocalic liquids. As with all EMMA studies, the location of the tongue inbetween tranceiver fleshpoints cannot be directly determined, and must be interpolated.

6.5 Summary

In this chapter, the consonantal phonology of Russian has been reviewed, and the behavior of liquid consonants within this system has been described. Diachronic phonological evidence, and evidence from the syllable-level phonotactics has been presented to argue for the existence of a class of liquids in Russian. Two important properties of this class are a preference to appear closer to the nucleus in the organization of clusters, and a tendency to interact with the nucleus (metathesis, liquid diphthongs, interaction with the jers).

A survey of the phonetic literature has revealed a lack of articulatory data on Russian consonants in general, and liquids in particular. More data is required to better understand nature of the palatalized/non-palatalized contrast, and the goals of production of the liquids. In Chapter 7, an experimental study designed to shed more light on the phonetic characterization of the class of Russian liquids will be described. The goal of this study is to examine the dynamic articulation of the four liquids of Russian, and in particular:

i. compare the production of the liquids with the production of coronal obstruents in Russian
ii. characterize the articulatory realization of the palatalized/non-palatalized consonantal contrast
iii. compare the dorsal articulation of the liquids with that of the non-palatalized obstruents