

Online Appendix for: Discretionary Task Ordering: Queue Management in Radiological Services

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To confirm the robustness of our findings, we conduct further analyses. We find that the results are robust to the use of a Linear Probability Model (LPM) rather than the probit regression used in our main models (Table A.1., Column 1), the use of a radiologist's case volume as an alternative measure of experience (Table A.1., Column 2), the inclusion of hospital fixed effects (Table A.1., Column 3), and to alternative cutoffs for shift breaks (Table A.2.). We explore the longer-term speed performance effects of deviations, and find that past deviations (measured as either proportions of deviations prior to the current case, not including the focal case, or proportions of deviations prior to the current shift) do not affect current speed (Table A.3.). We also explore the effect of past SEPT on speed-performance, and find that alternative measures of past SEPT are associated with slower reading times (Table A.4.).

Table A.1. Robustness Checks: Linear Probability Model, Experience Measure, and Hospital Fixed Effects

Dependent Variable: Model:	(1) DEVIATION LPM	(2a) DEVIATION EXPERIENCE:	(2b) LnREADTIME Volume of Cases	(3a) DEVIATION Hospital Fixed Effects	(3b) LnREADTIME
QSIZE	0.0183*** (0.0013)	0.0506*** (0.0039)	-0.0276*** (0.0023)	0.0515*** (0.0038)	-0.0273*** (0.0022)
QVARIETY	0.1113*** (0.0074)	0.3536*** (0.0206)	-0.1905*** (0.0143)	0.3460*** (0.0193)	-0.1830*** (0.0137)
NUM_IMAGES	-0.0030 (0.0036)	-0.0088 (0.0100)	0.1711*** (0.0062)	-0.0067 (0.0099)	0.1710*** (0.0063)
ORDER_IN_SHIFT	-0.0001*** (0.0000)	-0.0004*** (0.0001)	-0.0003*** (0.0001)	-0.0005*** (0.0001)	-0.0004*** (0.0001)
EXPERIENCE	0.0779*** (0.0057)	0.0046*** (0.0005)	-0.0017*** (0.0005)	0.2138*** (0.0156)	-0.0459*** (0.0123)
SEPT_OPPTY	0.0281*** (0.0028)	0.0650*** (0.0068)		0.0682*** (0.0068)	
REPEAT_OPPTY	0.0145*** (0.0014)	0.0417*** (0.0049)		0.0431*** (0.0048)	
RESTART			0.8329*** (0.0196)		0.8330*** (0.0196)
DEVIATION			0.0796*** (0.0143)		0.0487*** (0.0163)
DEVIATION *EXPERIENCE			-0.0003** (0.0001)		-0.0088*** (0.0034)
SEPT			0.0163*** (0.0051)		0.0143*** (0.0051)
SEPT*DEVIATION			0.0358*** (0.0047)		0.0443*** (0.0049)
REPEAT			-0.0098** (0.0047)		-0.0112** (0.0046)
REPEAT *DEVIATION			-0.0175*** (0.0049)		-0.0140*** (0.0048)
Rho			-0.0435***		-0.0085
Rho Standard Error			(0.0108)		(0.0116)

Notes. This table reports the results from the linear probability model (LPM) of the deviation equation (Column 1); and maximum-likelihood estimation (Columns 2 and 3) of the probit deviation model (a) and the performance model (b). The unit of observation is a radiologist's case. The number of observations is 2,408,218. R-squared is 0.1336 for the results in Column 1. Robust standard errors (in parentheses) are clustered by radiologist. In Column 2, EXPERIENCE is the number of cases interpreted by this radiologist up to the current case, in thousands. All specifications include case type (modality and anatomy), radiologist, day of week, and year fixed effects. The specifications in Columns 1a, 2a, and 3a also include fixed effects for the case type of the first case in the queue. The specification in Column 3a also includes hospital fixed effects. *10% statistical significance; **5% statistical significance; ***1% statistical significance.

Table A.2. Robustness Checks: Alternative Shift-Break Cutoffs

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)
Dependent Variable:	DEVIATION	LnREADTIME	DEVIATION	LnREADTIME	DEVIATION	LnREADTIME	DEVIATION	LnREADTIME	DEVIATION	LnREADTIME
Shift-Break Cutoffs:	20-minutes	20-minutes	40-minutes	40-minutes	60-minutes	60-minutes	90-minutes	90-minutes	480-minutes	480-minutes
QSIZE	0.0519*** (0.0039)	-0.0273*** (0.0021)	0.0508*** (0.0038)	-0.0280*** (0.0022)	0.0505*** (0.0037)	-0.0280*** (0.0022)	0.0504*** (0.0037)	-0.0280*** (0.0022)	0.0502*** (0.0037)	-0.0280*** (0.0023)
QVARIETY	0.3608*** (0.0193)	-0.1820*** (0.0140)	0.3363*** (0.0196)	-0.1895*** (0.0141)	0.3294*** (0.0199)	-0.1900*** (0.0139)	0.3276*** (0.0199)	-0.1900*** (0.0139)	0.3260*** (0.0199)	-0.1899*** (0.0139)
NUM_IMAGES	-0.0119 (0.0100)	0.1617*** (0.0058)	-0.0060 (0.0103)	0.1713*** (0.0062)	-0.0053 (0.0103)	0.1714*** (0.0062)	-0.0053 (0.0103)	0.1714*** (0.0062)	-0.0052 (0.0103)	0.1713*** (0.0062)
ORDER_IN_SHIFT	-0.0004*** (0.0001)	-0.0003*** (0.0001)	-0.0004*** (0.0001)	-0.0004*** (0.0001)	-0.0003*** (0.0001)	-0.0004*** (0.0001)	-0.0003*** (0.0001)	-0.0004*** (0.0001)	-0.0002** (0.0001)	-0.0004*** (0.0001)
EXPERIENCE	0.2208*** (0.0158)	-0.0457*** (0.0124)	0.2194*** (0.0158)	-0.0484*** (0.0124)	0.2194*** (0.0158)	-0.0480*** (0.0124)	0.2195*** (0.0157)	-0.0478*** (0.0124)	0.2194*** (0.0157)	-0.0479*** (0.0124)
SEPT_OPPTY	0.0707*** (0.0066)		0.0634*** (0.0068)		0.0618*** (0.0069)		0.0614*** (0.0069)		0.0615*** (0.0069)	
REPEAT_OPPTY	0.0437*** (0.0049)		0.0502*** (0.0053)		0.0559*** (0.0058)		0.0575*** (0.0060)		0.0594*** (0.0062)	
RESTART		0.7994*** (0.0193)		0.8683*** (0.0200)		0.8808*** (0.0223)		0.8880*** (0.0229)		0.8975*** (0.0237)
DEVIATION		0.0797*** (0.0140)		0.0882*** (0.0145)		0.0899*** (0.0142)		0.0902*** (0.0142)		0.0905*** (0.0141)
DEVIATION*		-0.0091*** (0.0035)		-0.0091*** (0.0034)		-0.0094*** (0.0033)		-0.0093*** (0.0033)		-0.0091*** (0.0032)
EXPERIENCE										
SEPT		0.0142*** (0.0051)		0.0165*** (0.0051)		0.0167*** (0.0051)		0.0168*** (0.0051)		0.0167*** (0.0051)
SEPT*		0.0380*** (0.0048)		0.0369*** (0.0047)		0.0365*** (0.0047)		0.0363*** (0.0047)		0.0360*** (0.0047)
DEVIATION										
REPEAT		-0.0081* (0.0046)		-0.0101** (0.0047)		-0.0103** (0.0047)		-0.0104** (0.0047)		-0.0103** (0.0047)
REPEAT*		-0.0175*** (0.0048)		-0.0173*** (0.0049)		-0.0173*** (0.0049)		-0.0173*** (0.0049)		-0.0172*** (0.0049)
DEVIATION										

Notes. This table reports the results from maximum-likelihood estimation of the probit deviation model (a) and the performance model (b). The unit of observation is a radiologist's case. The number of observations is 2,387,032, 2,412,544, 2,415,623, 2,416,535 and 2,417,453 in Columns 1, 2, 3, 4, 5, respectively. Rho (Standard Error) is -0.0384*** (0.0101), -0.0445*** (0.0105), -0.0455*** (0.0105), -0.0459*** (0.0105), -0.0464*** (0.0104) in Columns 1, 2, 3, 4, 5, respectively. Robust standard errors (in parentheses) are clustered by radiologist. All specifications include case type (technology and anatomy), radiologist, day of week, and year fixed effects. The probit specifications also include fixed effects for the case type of the first case in the queue. *** p<0.01, ** p<0.05, * p<0.1

Table A.3. Longer-Term Speed Performance Effects of Deviations

Dependent Variable:	(1a) DEVIATION	(1b) LnREADTIME	(2a) DEVIATION	(2b) LnREADTIME
QSIZE	0.0511*** (0.0038)	-0.0280*** (0.0022)	0.0512*** (0.0038)	-0.0348*** (0.0026)
NUM_IMAGES	-0.0079 (0.0101)	0.1711*** (0.0062)	-0.0080 (0.0101)	0.1938*** (0.0067)
ORDER_IN_SHIFT	-0.0002* (0.0001)	-0.0004*** (0.0001)	-0.0004*** (0.0001)	-0.0004*** (0.0001)
QVARIETY	0.3488*** (0.0195)	-0.1894*** (0.0141)	0.3472*** (0.0195)	-0.2231*** (0.0167)
SEPT_OPPTY	0.0660*** (0.0067)		0.0660*** (0.0067)	
REPEAT_OPPTY	0.0414*** (0.0048)		0.0421*** (0.0048)	
EXPERIENCE	0.2090*** (0.0159)	-0.0486*** (0.0125)	0.2195*** (0.0160)	-0.0570*** (0.0152)
RESTART		0.8336*** (0.0196)		0.9725*** (0.0247)
DEVIATION		0.0872*** (0.0146)		0.1047*** (0.0175)
DEVIATION*EXPERIENCE		-0.0090*** (0.0034)		-0.0119*** (0.0044)
SEPT		0.0161*** (0.0051)		0.0156*** (0.0059)
DEVIATION*SEPT		0.0374*** (0.0047)		0.0422*** (0.0057)
REPEAT		-0.0099** (0.0047)		-0.0045 (0.0061)
DEVIATION*REPEAT		-0.0169*** (0.0048)		-0.0261*** (0.0059)
DEV_UP_TO_NOW	0.0000*** (0.0000)	-0.0000 (0.0000)		
DEV_PRIOR_SHIFTS			0.0000 (0.0000)	0.0000*** (0.0000)
Observations	2,408,218	2,408,218	2,406,214	2,406,214
Rho	-0.0438***		-0.0468***	
Rho Standard Error	(0.0106)		(0.0098)	

Notes. This table reports the results from maximum-likelihood estimation of the probit deviation model (a) and the performance model (b). The unit of observation is a radiologist's case. **DEV_UP_TO_NOW** is the proportion of prior cases (not including the focal case) interpreted by this radiologist that were deviations from the first case in the queue. **DEV_PRIOR_SHIFTS** is the proportion of cases interpreted by this radiologist before the start of the current shift that were deviations from the first case in the queue. Robust standard errors (in parentheses) are clustered by radiologist. All specifications include case type (technology and anatomy), radiologist, day of week, and year fixed effects. The probit specifications also include fixed effects for the case type of the first case in the queue. *** p<0.01, ** p<0.05, * p<0.1

Table A.4. Panel A. The Effect of Past SEPT on Speed-Performance

Dependent Variable:	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	DEVIATION	LnREADTIME	DEVIATION	LnREADTIME	DEVIATION	LnREADTIME
Model:	One lag of SEPT		Two lags of SEPT		Three lags of SEPT	
QSIZE	0.0512*** (0.0038)	-0.0273*** (0.0022)	0.0512*** (0.0038)	-0.0271*** (0.0022)	0.0513*** (0.0038)	-0.0270*** (0.0022)
NUM_IMAGES	-0.0080 (0.0101)	0.1712*** (0.0063)	-0.0080 (0.0101)	0.1712*** (0.0063)	-0.0080 (0.0101)	0.1713*** (0.0063)
ORDER_IN_SHIFT	-0.0004*** (0.0001)	-0.0003*** (0.0001)	-0.0004*** (0.0001)	-0.0003*** (0.0001)	-0.0004*** (0.0001)	-0.0003*** (0.0001)
EXPERIENCE	0.2200*** (0.0158)	-0.0470*** (0.0125)	0.2200*** (0.0158)	-0.0465*** (0.0125)	0.2200*** (0.0158)	-0.0463*** (0.0125)
QVARIETY	0.3466*** (0.0194)	-0.1752*** (0.0137)	0.3465*** (0.0194)	-0.1732*** (0.0135)	0.3465*** (0.0194)	-0.1728*** (0.0134)
SEPT_OPPTY	0.0668*** (0.0067)		0.0668*** (0.0067)		0.0669*** (0.0067)	
REPEAT_OPPTY	0.0417*** (0.0049)		0.0419*** (0.0049)		0.0419*** (0.0049)	
RESTART		0.8233*** (0.0192)		0.8221*** (0.0191)		0.8219*** (0.0191)
DEVIATION		0.0764*** (0.0150)		0.0753*** (0.0150)		0.0750*** (0.0150)
DEVIATION * EXPERIENCE		-0.0092*** (0.0034)		-0.0092*** (0.0034)		-0.0093*** (0.0034)
SEPT		0.0114** (0.0050)		0.0111** (0.0049)		0.0110** (0.0049)
DEVIATION * SEPT		0.0376*** (0.0047)		0.0373*** (0.0046)		0.0372*** (0.0046)
REPEAT		-0.0325*** (0.0048)		-0.0316*** (0.0047)		-0.0315*** (0.0047)
DEVIATION * REPEAT		-0.0172*** (0.0048)		-0.0172*** (0.0048)		-0.0172*** (0.0048)
SEPT_L1		0.0337*** (0.0040)		0.0329*** (0.0039)		0.0328*** (0.0039)
SEPT_L2				0.0108*** (0.0022)		0.0104*** (0.0021)
SEPT_L3						0.0041** (0.0017)
Observations	2,408,218	2,408,218	2,408,176	2,408,176	2,408,130	2,408,130
Rho	-0.0323***		-0.0308***		-0.0304***	
Rho Standard Error	(0.0112)		(0.0112)		(0.0112)	

Notes. This table reports the results from maximum-likelihood estimation of the probit deviation model (a) and the performance model (b). The unit of observation is a radiologist's case. **SEPT_L1**, **SEPT_L2** and **SEPT_L3** are the one-period, two-period, and three-period lagged values of SEPT, respectively. **SEPT_IN_SHIFT** is the proportion of prior cases so far in the shift that were consistent with a SEPT policy. Robust standard errors (in parentheses) are clustered by radiologist. All specifications include case type (technology and anatomy), radiologist, day of week, and year fixed effects. The probit specifications also include fixed effects for the case type of the first case in the queue. *10% statistical significance; **5% statistical significance; ***1% statistical significance.

Table A.4. Panel B. The Effect of Past SEPT on Speed-Performance

Dependent Variable:	(4a) DEVIATION	(4b) LnREADTIME
Model:	Proportion of Past SEPT	
QSIZE	0.0512*** (0.0038)	-0.0282*** (0.0022)
NUM_IMAGES	-0.0080 (0.0101)	0.1710*** (0.0062)
ORDER_IN_SHIFT	-0.0004*** (0.0001)	-0.0004*** (0.0001)
EXPERIENCE	0.2200*** (0.0158)	-0.0495*** (0.0126)
QVARIETY	0.3473*** (0.0195)	-0.1905*** (0.0141)
SEPT_OPPTY	0.0659*** (0.0067)	
REPEAT_OPPTY	0.0419*** (0.0048)	
RESTART		0.8344*** (0.0194)
DEVIATION		0.0882*** (0.0147)
DEVIATION * EXPERIENCE		-0.0090*** (0.0035)
SEPT		0.0173*** (0.0048)
DEVIATION * SEPT		0.0373*** (0.0047)
REPEAT		-0.0092** (0.0046)
DEVIATION * REPEAT		-0.0170*** (0.0049)
SEPT_IN_SHIFT		-0.0177 (0.0145)
Observations	2,408,218	2,408,218
Rho	-0.0450***	
Rho Standard Error	(0.0106)	

Notes. This table reports the results from maximum-likelihood estimation of the probit deviation model (a) and the performance model (b). The unit of observation is a radiologist's case. **SEPT_L1**, **SEPT_L2** and **SEPT_L3** are the one-period, two-period, and three-period lagged values of SEPT, respectively. **SEPT_IN_SHIFT** is the proportion of prior cases so far in the shift that were consistent with a SEPT policy. Robust standard errors (in parentheses) are clustered by radiologist. All specifications include case type (technology and anatomy), radiologist, day of week, and year fixed effects. The probit specifications also include fixed effects for the case type of the first case in the queue. *10% statistical significance; **5% statistical significance; ***1% statistical significance.