AN EMPIRICAL COMPARISON OF PIE vs. LINEAR MENUS

ABSTRACT

Menus are largely formatted in a linear fashion listing items from the top to bottom of the screen or window. Pull down menus are a common example of this format. Bitmapped computer displays, however, allow greater freedom in the placement, font, and general presentation of menus. A pie menu is a format where the items are placed along the circumference of a circle at equal radial distances from the center. Pie menus gain over traditional linear menus by reducing target seek time, lowering error rates by fixing the distance factor and increasing the target size in Fitts's Law, minimizing the drift distance after target selection, and are, in general, subjectively equivalent to the linear style.

KEYWORDS

menus, user interface, empirical studies, directional selection.

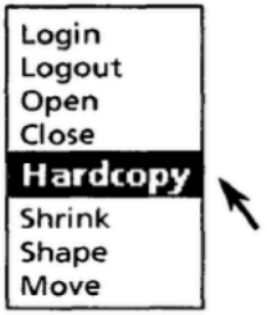

Figure 1: A typical linear menu

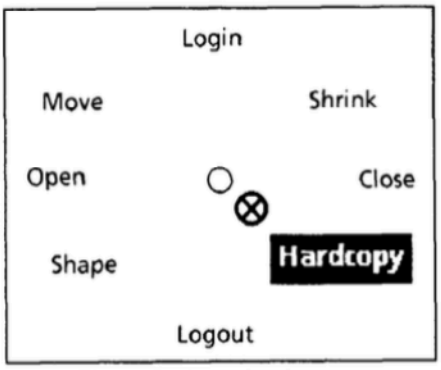

Figure 2: A crude pie menu

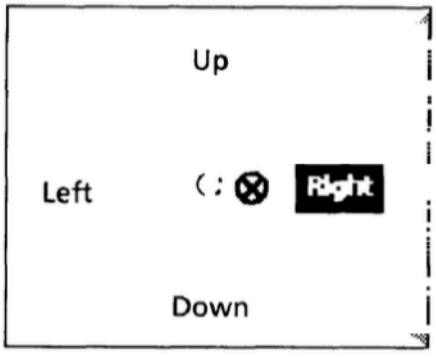

Figure 3: Pie menu activation region

Pie	*Linear*	*Unclassified*
North	First	Center
NE	Second	Bold
East	Third	Italic
SE	Fourth	Font
South	Fifth	Move
SW	Sixth	Copy
West	Seventh	Find
NW	Eighth	Undo

Table 1: Task groupings

	Task type			
	Pie	Linear	Unclass.	$Mean_{menu}$
Using pie menus	2.20	2.18	2.40	2.26
Using linear menus	2.68	2.30	2.94	2.64
$Mean_{task}$	2.44	2.24	2.67	

Table 2: Target seek time (sec) means per cell, menu type, and task type

	F	$PR > F$
Menu type	16.23	0.0003
Task type	6.93	0.0030
Menu type X Task type	2.82	0.0750

Table 3: repeated measures analysis of variance results for target seek time

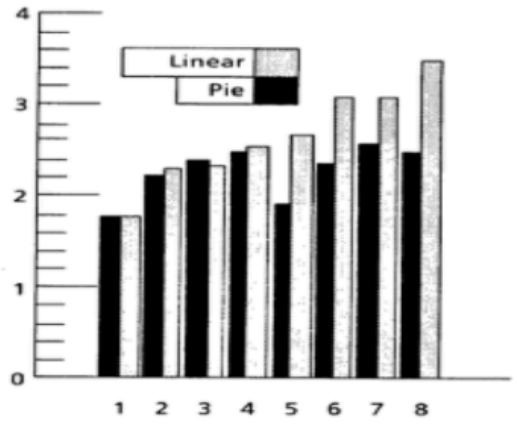

Figure 4: Target location (x) vs. seek time (y) in seconds

	Task type			
	Pie	Linear	Unclass.	$Mean_{menu}$
Using pie menus	0.45	0.60	0.60	0.55
Using linear menus	0.88	0.73	1.24	0.95
$Mean_{task}$	0.66	0.66	0.92	

Table 4: number of errors means per cell, menu type, and task type (all observations including no errors)

	F	*PR > F*
Menu type	3.12	0.0869
Task type	0.93	0.4066
Menu type *X* Task type	1.34	0.2773

Table 5: repeated measures analysis of variance results for number of errors

CONCLUSIONS

What does this mean? Should we program pie menus into our bitmapped window systems tomorrow and expect a 15-20% increase in productivity since users can select items slightly faster with pie menus. Pie menus seem promising, but more experiments are needed before issuing a strong recommendation.

This experiment only addresses fixed length menus, in particular, menus consisting of 8 items - no more, no less. Secondly, there remains the problem of increased screen real estate usage, In one trial a subject complained because the pie menu obscured his view of the target prompt message. Finally, the questionnaire showed that the subjects were almost evenly divided between pie and linear menus in subjective satisfaction. Many found it difficult to "home in on" a particular item because of the unusual activation region characteristics of the pie menu.

One assumption of this study concerns the use of a mouse/cursor control device and the use of pop-up style menus (as opposed to menus invoked from a fsed screen location or permanent menus). Certainly, pie menus can and in fact have been incorporated to use keyed input [7] and fixed "pull-down" style presentation (the pie menu becomes a semicircle menu). These variations are areas for further research.

One continuing issue with pie menus is the limit on the number of items that can be placed in a circular format before the size of the menu window is impractical. Perhaps, like the limiting factors in linear menus concerning their lengths, pie menus reach a sim.- ilar "breaking point" beyond

which other menu styles would be more useful. Hierarchical organization, arbitrarily shaped windows (Figure S), numeric item assignment and other menu refinements as well as further analysis is contained in [7]. Pie menus offer a novel alternative worthy of further exploration.

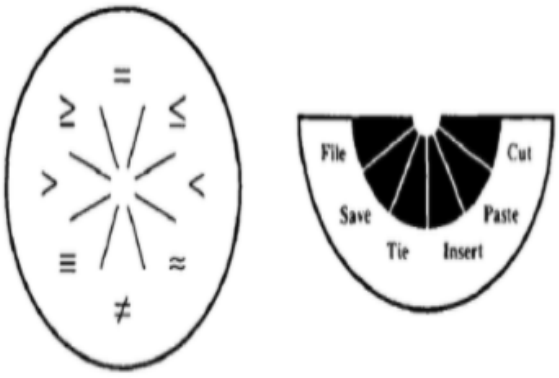

Figure 6: Advanced "pie" menus