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The effects of practice on cueing in detection and discrimination tasks

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We report two experiments that examine the effects of practice on the early facilitation and later inhibition of return (IOR) effects of cueing in detection and color-discrimination tasks. In the first experiment a short and a long SOA were mixed within a block of trials, so that there was temporal uncertainty. In the second experiment SOA was manipulated between subjects, to eliminate temporal uncertainty. Facilitation and IOR effects were obtained in the short and long SOAs respectively, in both detection and discrimination tasks, and they consistently decreased with practice. The cueing effects were more positive (i.e., bigger facilitation and smaller IOR) in the discrimination task than in the detection task. Cueing and practice effects were modulated by temporal uncertainty (Experiment 1 vs. Experiment 2). Our results go some way to resolving some of the contradictory findings in the literature.

Keywords: IOR, facilitation, practice effects, spatial attention, orienting of attention, detection tasks, discrimination tasks.

It is widely presumed that spatial attention can modulate perception and later processing of information. During the last two decades, different studies have shown that responses to targets are facilitated if attention is previously oriented to the location where the target appears. In the cueing

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paradigm (Posner, 1980; Posner & Cohen, 1984) subjects respond to a target that can appear in one of two boxes while maintaining fixation at the center of the display. One of the peripheral boxes is flashed before the target appears thus summoning attention to this location, and responses to the target are usually faster when they appear at this cued location than when they appear at the uncued location. Interestingly, this facilitatory effect appears in conditions in which the cue does not predict the target location, or even when subjects are not aware of the cue (McCormick, 1997), which leads to the conclusion that attention can be oriented automatically.

However, the facilitatory effect lasts just a few hundred ms. Posner and Cohen (1984) showed that when the interval between cue and target (SOA) is 300 ms or greater, the pattern of results was reversed, such that Reaction Time (RT) was longer on cued than on uncued trials. Posner, Rafal, Choate, and Vaughan (1985) coined the term *inhibition of return* (IOR) to describe this effect (see Lupiáñez, Tudela & Rueda, 1999, and Klein, 2000, for reviews).

Since Posner and Cohen's classic study, both facilitation and IOR effects have been replicated using different procedures. Facilitatory effects have been obtained at SOAs shorter than 200 ms in detection, localization and discrimination tasks, within and between sensorial modalities (Lupiáñez, Milán, Tornay, Madrid & Tudela, 1997; Maylor, 1985; Milán, 1997; Mondor, Breau, & Milliken, 1998; Müller & von Mühlenen, 1996; Possamaï, 1986; Spence & Driver, 1997; Van der Heijden, Wolters & Enkeling, 1988). On the other hand, at SOAs longer than 300 ms IOR has now been reported with different response modalities, such as manual key-press (Posner & Cohen, 1984) and eye movement latency (Abrams & Dobkin, 1994; Maylor, 1985; Pratt, 1995). Finally, it has also been shown that both facilitation and IOR could not only act in location-based frames of reference, but also in object-based frames (Egly, Driver and Rafal, 1994; Gibson & Egeth, 1994; Jordan & Tipper, 1998; Tipper, Driver & Weaver, 1991; Tipper, Weaver, Jerreat, & Burak, 1994).

However, other studies have challenged the assumed properties of exogenous cueing. For example, although previous reports suggested that the inhibitory effect could be obtained in both target detection and localization tasks, it was *not* observed in discrimination tasks (Klein & Taylor, 1994; Egly, Rafal & Henik ,1992; Tanaka & Shimojo,1996; Terry, Valdes & Neill, 1994). However, many researchers in different laboratories have recently obtained IOR using a variety of discrimination tasks (e.g., color discrimination, Lupiáñez et al., 1997; shape discrimination, Cheal, Chastain, and Lyon, 1998, Lupiáñez, Milliken, Weaver & Tipper, in press;

Pratt, Kingstone & Khoe, 1997; frequency discrimination, Mondor, Breau, & Milliken, 1998; and direction discrimination, Lupiáñez, Tornay, & Tudela, 1996).

Other studies have challenged the robustness of the facilitation observed when the interval between cue and target is short, as they failed to replicate the effect (e.g., Tassinari, Aglioti, Chelazzi, Peru, & Berlucchi, 1994; Riggio, Bello, & Umiltà, 1998). For example, Riggio et al. (1998) observed that "*the facilitation resulting from an uninformative peripheral cue was at best an elusive effect*", and Tassinari et al. (1994) consistently failed to find any facilitation effect in four experiments; they found only a negative effect, even at SOAs as short as 0 and 65 ms.

Finally, Müller & von Mühlenen (1996) have argued against the robustness and functional importance of the object-based IOR effect. However, an issue that has not been carefully considered, which may be critical to the nature of cueing effects, is the level of experience with a task. That is, experimental effects can vary with practice, and this variable should be held constant when attempting to replicate. Therefore, Weaver, Lupiáñez and Watson (1998) conducted an experiment to explore the effects of practice on object-based and location-based IOR. Using a dynamic display (in which the boxes where cue and target were displayed moved around the screen between the cue and target displays), they observed that both object- and location-based effects decreased significantly with practice; after 170 trials the effects were dramatically reduced from -19 to -6 ms on average. In a subsequent experiment, Weaver et al. (1998) used the standard static display, and even in this situation they observed that IOR decreased significantly with practice.

In Müller and von Mühlenen's (1996) experiments, subjects participated in an unrecorded practice session, and so Weaver et al. (1998) argued that Müller and von Mühlenen may have failed to detect any object-based IOR effect because it had disappeared by the time they started collecting data. Similarly, in Tassinari et al.'s (1994) study subjects were practiced, and some of them participated in several experiments [note 1]. Riggio et al.'s (1998) experiments were long enough (768 and 1152 experimental trials, plus practice) to be influenced by practice effects. Therefore, as in Müller and von Mühlenen (1996), practice could be one explanation for their failure to observe facilitation effects. We decided therefore to examine the effect of practice on both the early facilitatory and the later IOR effects of cueing.

Another important motivation to explore the effects of practice on facilitation is to test the hypothesis that IOR is reduced with practice because subjects habituate to the cue. If this hypothesis is true both facilitation and IOR should be similarly influenced by practice; habituation to the cue should lead to its loss of effectiveness and so to smaller facilitation and IOR effects. On the other hand, the decrease of IOR across practice might be due to an increase in the effectiveness of the cue (thus increasing facilitatory effects), or to the fact that practiced subjects tend to maintain attention at the cued location on some trials. In these two latter cases the decrease in IOR should be accompanied by an increase in the facilitation effect observed at a short SOA.

The main aim of the present research was to study the effects of practice on facilitation and IOR in detection and discrimination tasks, in an attempt to replicate Weaver et al.'s (1998) results with a different procedure. We used the same procedure that Lupiáñez et al. (1997) used, to see whether the IOR effects they observed in a color discrimination task could survive after practice, or, as in the case of location- and object-based IOR effects, would disappear after a few hundred trials.

EXPERIMENT 1: SOA MIXED

The first experiment used the same procedure as Lupiáñez et al. (1997, Experiments 3A & 3B), but the same program was run 12 times (4 times each day for three consecutive days). Therefore, only a description of the important procedural features is provided here; for more specific details, see Lupiáñez et al. (1997, General Method). The SOA was manipulated within subjects, mixed within blocks of trials, so that there was temporal uncertainty.

METHOD

Subjects. All subjects in these experiments were from the Faculty of Psychology of the University of Granada. Subjects were naive as to the purpose of the experiment and participated in exchange for course credit. A different group of 10 subjects participated in each experimental group (detection and discrimination), in three consecutive days. One subject in each group did not finish the 12 sessions, so that data from only 9 subjects in each group will be reported.

Apparatus and Stimuli. Stimuli were presented on a 14-inch color VGA monitor. An IBM compatible 486/33 microcomputer, running MEL software (Schneider, 1988) controlled the presentation of stimuli, timing operations and data collection. In the detection task subjects pressed one single key of the keyboard, while in the discrimination task they pressed one of two keys, depending on the color of the target.

Procedure. The target on each trial appeared in the center of one of two boxes, which were displayed in dark gray on a black background, to the left and right of fixation. The boxes remained on the screen throughout each trial, and only disappeared between trials. The target was a colored asterisk, either red or yellow with equal probability.

In each trial the fixation point was displayed together with the two boxes for 1000 ms, and then one of the two boxes flickered for 50 ms (cue). Following the flicker, the fixation point and the boxes remained on the screen for 50, or 950 ms, depending on the SOA for that trial. Then, the target was displayed. After 33 ms it disappeared and the fixation point and boxes were again displayed alone until subjects' response, or for a maximum of 2000 ms, when the next trial began if no response had been made. The interval between trials was 1000 ms in duration, and the screen remained black throughout this interval.

In the detection task, subjects were given instructions to press the "B" key regardless of the color of the asterisk. In the discrimination task half of the subjects were to press the "X" key when the asterisk was yellow and the "M" key when it was red, and the other half did the opposite. In both tasks there were a few catch trials (20%), on which no target appeared. Auditory feedback was provided on error trials.

The experiment was interrupted for one minute every 50 trials to allow the subject to rest. Subjects resumed by pressing the space bar after the rest break.

Design. Two independent variables were orthogonally manipulated in each block of trials. The first variable was the SOA from onset of the peripheral cue to onset of the target. The two levels of SOA were 100 ms and 1000 ms. The second variable was Cueing. The target could appear either in the same box as the peripheral cue (cued trial) or in the opposite box (uncued trial). There was no predictive relation between the attentional cue and the target's location or color; and there was cue-target temporal uncertainty.

Subjects performed the experiment 4 times each day for three consecutive days (12 sessions). In each session they performed one practice block and 2 blocks of experimental trials. The practice block consisted of 8 trials of each combination of Cueing (2) x SOA (2), and eight catch trials (32 + 8 = 40 trials). Each block of experimental trials consisted of 20 trials of every combination and 20 catch trials (80 + 20 = 100 trials). Thus, each session consisted of 200 experimental trials, plus 40 practice trials.

RESULTS

Subjects made false alarms (responses to catch trials) on 5.74% of the short SOA trials and on 1.90% of the long SOA trials in the detection task. For the discrimination task, the figures were 0.32% and 0.19% for the short and long SOAs respectively. As in Lupiáñez et al. (1997), trials with correct responses faster than 100 ms or slower than 1200 ms (0.181% and 0.105% respectively, for the detection task, and 0.012% and 0.211% respectively for the discrimination task) were excluded from the RT analysis, as were trials with incorrect responses. Mean RTs and percent errors are shown in Table 1.

Analysis of RTs. Mean RTs of correct responses were introduced into a 2 x 12 x 2 x 2 mixed ANOVA treating Task (2) as a between subjects variable, and Session (12), SOA (2) and Cueing (2) as within subjects variables. The results of this ANOVA are shown in Table 2. As can be seen in the table, the analysis revealed significant main effects of Task, Session, and Cueing: Subjects performing the detection task were faster than those who performed the discrimination task; RT was shorter for uncued than cued trials; and RT decreased with practice. Task also interacted with Session, and Cueing: The main effect of cueing, although negative in both tasks, was smaller in the discrimination task than in the detection task, and the practice effect was bigger in the former.

The three-way interaction between Task, Session, and SOA was also significant. More interestingly, however, the Cueing x SOA and Session x Cueing x SOA interactions were also significant. To analyze how practice affected the cueing effects, two separate 12 x 2 x 2 ANOVAs were conducted on the data from each SOA (see Table 2).

The analysis of the data from the *short SOA* showed significant main effects of Task and Session, and significant Task x Session and Task x Cueing interactions. Responses was faster in the detection than the discrimination task, and overall RT decreased with practice. Both the facilitatory and practice effects were bigger in the discrimination task than in the detection task. The main effect of cueing was positive, but it was significant only in the discrimination task (+14 ms), $F(11, 176) = 9.83$, $MSerror = 1127.96$, $p < 0.01$. In the detection task, the cueing effect was negative (-4 ms) and not significant ($F < 1$). The most interesting result was a significant Session x Cueing interaction, showing that the facilitation effect decreased across sessions. The three-way interaction was not significant ($F < 1$), thus showing that practice affected the facilitatory effect similarly in both tasks.

Table 1. Mean RTs (in ms) for correct responses, miss (in parentheses), and discrimination error rates [in square brackets] for Experiment 1 (within subjects, within blocks, SOA manipulation)

	Short SOA (100 ms)						Long SOA (1000 ms)					
	Detection			Discrimination			Detection			Discrimination		
Session	Cued	Uncue	Effect	Cued	Uncue	Effect	Cued	Uncue	Effect	Cued	Uncue	Effect
1	314	320	**7**	520	546	**26**	340	301	**-39**	579	535	**-45**
	(2,50)	(1,11)	-(1,39)	(3,06)	(1,39)	-(1,67)	(0,56)	(0,83)	(0,28)	(4,72)	(3,06)	-(1,67)
				[7,22]	[8,61]	[1,39]				[5,83]	[4,44]	-[1,39]
2	301	301	**1**	496	514	**18**	340	300	**-40**	514	500	**-14**
	(1,11)	(0,83)	-(0,28)	(2,22)	(1,11)	-(1,11)	(1,11)	(0,28)	-(0,83)	(1,11)	(1,39)	(0,28)
				[4,17]	[3,89]	-[0,28]				[4,44]	[5,56]	[1,11]
3	294	297	**4**	481	497	**16**	317	286	**-31**	502	488	**-14**
	(0,56)	(0,00)	-(0,56)	(1,39)	(1,67)	(0,28)	(0,28)	(0,83)	(0,56)	(1,39)	(0,56)	-(0,83)
				[3,61]	[6,11]	[2,50]				[3,89]	[4,17]	[0,28]
4	296	300	**4**	473	491	**18**	324	281	**-43**	500	470	**-29**
	(1,11)	(0,56)	-(0,56)	(1,39)	(0,56)	-(0,83)	(0,56)	(1,39)	(0,83)	(0,56)	(0,83)	(0,28)
				[4,17]	[5,83]	[1,67]				[4,72]	[4,17]	-[0,56]
5	296	292	**-4**	467	482	**14**	310	276	**-34**	493	464	**-28**
	(1,39)	(0,00)	-(1,39)	(0,28)	(0,00)	-(0,28)	(0,56)	(0,28)	-(0,28)	(0,00)	(0,00)	(0,00)
				[2,50]	[1,67]	-[0,83]				[2,50]	[2,50]	[0,00]
6	300	289	**-11**	471	476	**5**	316	279	**-37**	498	467	**-31**
	(0,28)	(1,39)	(1,11)	(0,56)	(0,00)	-(0,56)	(0,56)	(0,28)	-(0,28)	(0,00)	(0,00)	(0,00)
				[2,50]	[2,50]	[0,00]				[1,39]	[1,67]	[0,28]
7	299	296	**-3**	477	486	**9**	315	277	**-38**	499	476	**-23**
	(2,22)	(0,56)	-(1,67)	(0,83)	(0,83)	(0,00)	(0,28)	(0,28)	(0,00)	(0,83)	(0,00)	-(0,83)
				[3,89]	[1,94]	-[1,94]				[2,22]	[1,94]	-[0,28]
8	291	290	**-1**	469	481	**12**	310	278	**-32**	500	479	**-21**
	(1,11)	(0,83)	-(0,28)	(0,28)	(0,00)	-(0,28)	(0,28)	(0,28)	(0,00)	(0,28)	(0,00)	-(0,28)
				[3,89]	[0,83]	-[3,06]				[1,67]	[2,78]	[1,11]
9	292	276	**-16**	441	450	**9**	297	262	**-35**	459	441	**-18**
	(0,28)	(0,28)	(0,00)	(0,00)	(0,56)	(0,56)	(0,28)	(0,28)	(0,00)	(0,00)	(0,00)	(0,00)
				[2,22]	[2,50]	[0,28]				[0,28]	[1,94]	[1,67]
10	287	281	**-6**	452	466	**14**	305	263	**-42**	478	458	**-20**
	(1,11)	(0,56)	-(0,56)	(1,39)	(1,11)	-(0,28)	(0,28)	(0,28)	(0,00)	(0,28)	(0,00)	-(0,28)
				[4,17]	[3,33]	-[0,83]				[1,11]	[1,67]	[0,56]
11	292	284	**-8**	450	473	**22**	304	269	**-36**	471	456	**-15**
	(0,56)	(0,00)	-(0,56)	(0,28)	(1,94)	(1,67)	(1,11)	(0,83)	-(0,28)	(0,56)	(0,28)	-(0,28)
				[3,33]	[2,22]	-[1,11]				[3,89]	[1,94]	-[1,94]
12	293	283	**-10**	452	460	**8**	297	270	**-27**	484	466	**-17**
	(1,39)	(0,28)	-(1,11)	(0,28)	(0,83)	(0,56)	(0,56)	(0,83)	(0,28)	(0,83)	(0,56)	-(0,28)
				[4,72]	[4,44]	-[0,28]				[1,67]	[2,50]	[0,83]
Mean	296	293	-4	471	485	14	315	278	-36	498	475	-23
	(1,13)	(0,53)	-(0,60)	(1,00)	(0,83)	-(0,16)	(0,53)	(0,56)	(0,02)	(0,88)	(0,56)	-(0,32)
				[3,87]	[3,66]	-[0,21]				[2,80]	[2,94]	[0,14]

Table 2. Analysis of Variance of Experiment 1.

Global Analysis

Mixed design: Task(BS) x Session(WS) x SOA(WS) x Cueing(WS)

Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
Task	1	7539698,50	16	58842,19	128,13	**0,0000**
Session	11	22846,19	176	1767,65	12,92	**0,0000**
SOA	1	6413,94	16	2726,72	2,35	0,1446
Cueing	1	31654,21	16	1023,57	30,93	**0,0000**
Task x Session	11	3918,07	176	1767,65	2,22	**0,0155**
Task x SOA	1	2325,42	16	2726,72	0,85	0,3695
Session x SOA	11	323,16	176	238,45	1,36	0,1981
Task x Cueing	1	13053,37	16	1023,57	12,75	**0,0026**
Session x Cueing	11	187,00	176	215,21	0,87	0,5719
SOA x Cueing	1	65876,06	16	644,42	102,22	**0,0000**
Task x Session x SOA	11	507,39	176	238,45	2,13	**0,0206**
Task x Session x Cueing	11	124,01	176	215,21	0,58	0,8465
Task x SOA x Cueing	1	311,51	16	644,42	0,48	0,4969
Session x SOA x Cueing	11	435,92	176	120,34	3,62	**0,0001**
Task x Session x SOA x Cueing	11	96,47	176	120,34	0,80	0,6383

Analysis of the data from the Short SOA

Mixed design: Task(BS) x Session(WS) x Cueing(WS)

Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
Task	1	3638599,75	16	25674,03	141,72	**0,0000**
Session	11	9458,50	176	791,02	11,96	**0,0000**
Cueing	1	3100,55	16	1127,96	2,75	0,1168
Task x Session	11	2045,27	176	791,02	2,59	**0,0046**
Task x Cueing	1	8698,93	16	1127,96	7,71	**0,0135**
Session x Cueing	11	319,11	176	154,43	2,07	**0,0250**
Task x Session x Cueing	11	62,48	176	154,43	0,40	0,9527

Analysis of the data from the Long SOA

Mixed design: Task(BS) x Session(WS) x Cueing(WS)

Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
Task	1	3903424,00	16	35894,88	108,75	**0,0000**
Session	11	13710,85	176	1215,08	11,28	**0,0000**
Cueing	1	94429,73	16	540,03	174,86	**0,0000**
Task x Session	11	2380,20	176	1215,08	1,96	**0,0351**
Task X Cueing	1	4665,95	16	540,03	8,64	**0,0096**
<u>Session x Cueing</u>	11	303,81	176	181,12	1,68	<u>0,0818</u>
Task x Session x Cueing	11	158,01	176	181,12	0,87	0,5685

Note: BS stands for Between Subjects and WS for Within Subjects.
Significant effects are shown in bold, marginally effects are underlined.

In order to further analyze the development of practice effects, a different Task X Cueing X Session (6) mixed design ANOVA was carried out in the first and the second half of the experimental sessions. In the analysis of the first six sessions, the Session x Cueing interaction was significant, $F(5, 80) = 2.44$, $MSerror = 159.23$, $p < 0.05$, but not the three-way interaction ($F < 1$). The cueing effect decreased monotonically across sessions, as the linear component was significant, $F(1, 16) = 12.12$, $MSerror = 125.482$, $p < 0.005$, explaining 78.29% of the interaction. Furthermore, the linear component was significant in both detection and discrimination (both $ps < 0.05$). In the ANOVA carried out on the data from the last six sessions the Session x Cueing interaction was no longer significant ($p > 0.30$), neither was the three-way interaction ($F < 1$).

The analysis of the data from the *long SOA* showed significant main effects of Task, Session and Cueing. The effect of practice was bigger in the discrimination task (significant Task x Session interaction), and the cueing effect was bigger in the detection task (significant Task x Cueing interaction). Nevertheless, the IOR effect was highly significant in both detection (-36) and discrimination (-23) ($p < 0.0001$ in both). The Cueing x Session interaction was marginally significant; but the three-way interaction was not significant ($F < 1$).

As with the short SOA data, a different Task x Cueing x Session (6) mixed design ANOVA was carried out in the first and the second half of the experimental sessions. Interestingly, in the ANOVA carried out on the data from the first six sessions, the Task x Session and Task x Cueing interactions were significant, $F(5, 80) = 3.34$, $MSerror = 1160.92$, $p < 0.01$, and $F(1, 16) = 8.14$, $MSerror = 182.54$, $p < 0.05$, respectively. The Session x Cueing approached significance, $F(5, 80) = 1.94$, $MSerror = 219.98$, $p < 0.10$. The quadratic and cubic components were significant, but only for the discrimination task, $F(1, 16) = 7.97$, $MSerror = 182.70$, $p < 0.05$, and $F(1, 16) = 8.99$, $MSerror = 139.14$, $p < 0.01$. These components explained 44.00% and 49.64% of the interaction, respectively. No component approached significance in the data of the detection task. Thus, in the discrimination task IOR quickly decreased after the first session and then increased a bit to remain at this level throughout the following six sessions; whereas no important changes were observed across sessions in the detection task.

In the ANOVA carried out on the data from the last six sessions, neither the Session x Cueing interaction nor the three-way interaction approached significance (both $Fs < 1$).

Analysis of errors. In the discrimination task, subjects could make two different kinds of errors: miss (no response to the target) and discrimination error (incorrect response to the target). Only misses could be made in the detection task. Percentages of misses were analyzed with a mixed ANOVA that treated Task (2) as a between subjects variable, and Session (12), SOA (2) and Cueing (2) as within subjects variables. This analysis revealed a significant main effect of Session, $F(11, 176) = 3.40$, $MSerror = 5.62$, $p < 0.0005$, as the miss rate decreased with practice, especially from session 1 to session 2. The Task x Session x SOA interaction was also significant, $F(11, 176) = 2.36$, $MSerror = 2.06$, $p < 0.01$, showing that in the first session of the detection task subjects missed the target more at the short than at the long SOA, whereas in the discrimination task they missed the target more at the long SOA. No other effects were significant in this analysis.

The discrimination error rates were introduced into a repeated measures ANOVA treating Session (12), SOA (2) and Cueing (2) as within subjects variables. This analysis revealed significant main effects of Session and SOA, $F(11, 88) = 5.66$, $MSerror = 13.14$, $p < 0.0001$, and $F(1, 8) = 8.26$, $MSerror = 8.26$, $p < 0.05$, respectively: Subjects made more errors at the short SOA and during the first session of trials. No other effects were significant.

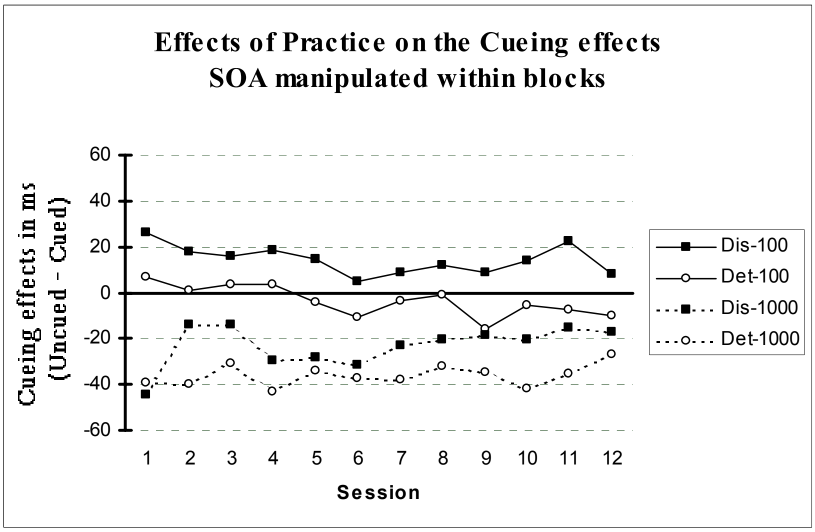

Figure 1. Results from Experiment 1. Mean cueing effects over 12 sessions of practice. Filled squares represent data from the detection task, and open circles represent data from the discrimination task. Full lines represent data from the 100 ms SOA, and broken lines represent data from the 1000 ms SOA.

DISCUSSION

In this experiment, significant practice effects were observed at both SOAs in both detection and discrimination task, although the practice effect was bigger in the latter. However, as can be observed in Figure 1, the influence of practice on the cueing effect was clearly observed with both tasks only in the short SOA. The facilitation effect observed at the 100 ms SOA was reduced with practice in both detection and discrimination tasks. In the detection task, the effect was positive in the first four sessions and then became negative. Although neither the early facilitation effect, nor the late negative effect, were significant, the cueing effect at the first four Sessions was significantly different from the effect observed at the last four sessions, $F(1, 8) = 12.01$, $MSerror = 135.57$, $p < 0.01$. In contrast, in the discrimination task, although the effect also decreased with practice, it remained positive (the effect was still significant in the data from the last two blocks of trials, $p < 0.01$).

At the long SOA, IOR also decreased with practice, but the decrease was mainly due to the discrimination task. In the detection task there was no evidence for a decrease in IOR across sessions (see Figure 1). Importantly, although IOR decreased with practice in the discrimination task, it did not disappear (there was significant IOR in the last session, $p < 0.05$).

Several findings are interesting in this experiment. First, the cueing effects seem to be shifted in a positive direction in the discrimination task relative to the detection task; that is, facilitation was smaller in detection than discrimination, and IOR was bigger. Second, the facilitation effect seems to be equally affected by practice in both tasks. It is interesting that the effect in the detection task disappeared with practice (and became negative), because that could explain why some authors, like Riggio et al. (1998), have failed to observe facilitation effects in detection tasks. Third, in agreement with Lupiáñez et al. (1997), IOR in discrimination tasks seems to be a robust effect, as it can persist after thousands of trials.

Nevertheless, IOR did not decrease with practice in the detection task. This task is most similar to Weaver et al. (1998), as they also used a detection task, and therefore the data of the present experiment seem to be in disagreement with their results; it seems reasonable to conclude that we did not replicate Weaver et al. (1998) with this procedure. It is important to note that the overall decrease in RT observed across sessions (practice effect) was significantly smaller in the detection (37 ms) than in the discrimination task (82 ms). Given that the display and procedure used in our experiment were quite simple, in the detection task a small amount of practice (during the first trials or during the block of practice) might have been enough to absorb all the decrease of IOR due to practice. A similar finding have been recently reported by Pratt and McAuliffe (1999), who reported a failure to replicate Weaver et al.'s results. Interestingly, the overall practice effect they observed across their three experiments was 36 ms, whereas Weaver et at. (1998) found an average of 86 ms practice effect.

Weaver et al. (1998) used only one SOA in their experiments, so that there was no temporal uncertainty (note that Pratt and McAuliffe, 1999, also used only one SOA). Thus, we ran the following experiment in which SOA was manipulated between subjects, to examine the role of temporal uncertainty on the practice effects, and to see whether we were able to replicate Weaver et al.'s (1998) findings.

EXPERIMENT 2: BLOCKED SOA

The main goal of this second experiment was to see whether temporal uncertainty modulates the effect of practice on cueing effects. The procedure we used in this experiment was very similar to the one used in the previous experiment, apart from the SOA manipulation and the number of blocks of trials that subjects performed. In the present experiment SOA was manipulated between subjects, so that there was *no* temporal uncertainty, and subjects participated in a single session of eight blocks of experimental trials.

METHOD

Subjects. All subjects in this experiment were from the same pool as the previous experiment. Subjects were naive as to the purpose of the experiment and participated in exchange for course credit. Two different groups of 18 subjects each participated in the short SOA groups, one with each task, and another two groups of 18 subjects each participated in the two tasks with long SOA. Subjects ran the experiment in groups, in a computer room equipped with 20 computers.

Apparatus and Stimuli. Everything was the same as in Experiment 1. The main difference was that this experiment was run in a computer room equipped with 20 computers.

Procedure. The only difference with the previous experiment regarding the procedure was that each subject experienced only one fixed cue-target interval, as SOA was manipulated between subjects.

Design. Task and SOA were manipulated between subjects. In each group of the Task x SOA combination, subjects performed one block of 20 practice trials, followed by 8 blocks of 100 trials. In each experimental block there were 40 cued trials, 40 uncued trials, and 20 catch trials. (In the practice block there were 8 cued, 8 uncued, and 4 catch trials.)

RESULTS

Rates of false alarms (response to catch trials) were 9.79% and 2.08% (for detection and discrimination respectively) in the short SOA groups, and 1.63% and 1.60% in the long SOA groups. Trials with correct responses faster than 100 ms or slower than 1200 ms [note 2], and incorrect responses, were excluded from the RT analysis. Mean RTs and percent errors are shown in Table 3.

Analysis of RTs. Mean RTs for correct responses were introduced into a 2 x 2 x 8 x 2 mixed ANOVA treating Task (2), and SOA (2) as between subjects variables, and Block (8), and Cueing (2) as within subjects variables. The results of this analysis are shown in Table 4. This analysis showed significant main effects of both Task and Block: Responses were faster in detection (347 ms) than in discrimination (538 ms); and overall RT decresased with practice. Cueing interacted with Task, because the overall cueing effect was positive in the discrimination task but negative in the detection task. The Cueing x SOA interaction was also significant, showing a facilitation effect at the short SOA and IOR at the long SOA.

There was a significant SOA x Block x Cueing interaction. To disentangle this interaction a separate ANOVA was conducted for each SOA, with Task as a between subjects variable, and Block and Cueing as within subjects variables.

For the *short SOA*, the three main effects were highly significant, showing task, practice and cueing (facilitation) effects. The Cueing x Task interaction was also significant, showing that the facilitation effect was bigger in the discrimination task (+27) than in the detection task (+13), although it was significant in both, $F(1, 34) = 48.98$, MSerror = 1032.89, $p < 0.0001$, and $F(1, 34) = 12.21$, MSerror = 1032.89, $p < 0.005$, respectively. Interestingly, the Block x Cueing interaction was also significant, but the three-way interaction was not ($F < 1$), showing that practice affected the cueing effect similarly in both tasks. In order to further analyze the practice effects a different 2(Task) x 2(Cueing) x 4(Block) ANOVA was performed on the data from the first and second half of the experiment. Facilitation decreased with practice in the first half, as the ANOVA performed on the data from the first four blocks of trials showed a marginally significant interaction between Block and Cueing, $F(3, 102) = 2.45$, MSerror = 357.42,

p = 0.0676. Only the linear component was significant, $F(1, 34) = 6.37$, MSerror = 366.19, $p < 0.02$, which explained 87% of the interaction.

Table 3. Mean RTs (in ms) for correct . responses, miss (in parentheses) and discrimination error rates [in square bracketts] for Experiment 2 (between subjects SOA manipulation).

	Short SOA (100 ms)						Long SOA (1000 ms)					
	Detection			Discrimination			Detection			Discrimination		
Block	Cued	Uncuec	Effect	Cued	Uncuec	Effect	Cued	Uncuec	Effect	Cued	Uncuec	Effect
1	334	355	**22**	549	594	**45**	397	361	**-36**	550	532	**-18**
	(1,94)	(1,39)	-(0,56)	(2,36)	(3,75)	(1,39)	(1,81)	(1,11)	-(0,69)	(1,39)	(1,11)	-(0,28)
				[5,69]	[5,00]	-[0,69]				[4,44]	[4,58]	[0,14]
2	327	343	**15**	531	562	**32**	395	360	**-35**	539	515	**-23**
	(0,83)	(0,97)	(0,14)	(1,11)	(1,67)	(0,56)	(0,97)	(0,83)	-(0,14)	(0,69)	(0,97)	(0,28)
				[3,47]	[4,17]	[0,69]				[3,19]	[3,06]	-[0,14]
3	320	335	**15**	535	558	**24**	381	352	**-29**	546	532	**-13**
	(10,69)	(11,94)	(1,25)	(4,03)	(4,31)	(0,28)	(3,06)	(2,64)	-(0,42)	(2,50)	(1,67)	-(0,83)
				[3,75]	[5,00]	[1,25]				[3,75]	[2,64]	-[1,11]
4	320	334	**14**	530	551	**21**	379	354	**-25**	538	524	**-14**
	(0,42)	(0,83)	(0,42)	(1,81)	(1,94)	(0,14)	(1,39)	(1,25)	-(0,14)	(0,42)	(0,83)	(0,42)
				[4,44]	[5,69]	[1,25]				[4,17]	[3,19]	-[0,97]
5	317	330	**13**	526	553	**27**	369	349	**-20**	530	529	**-1**
	(0,14)	(1,11)	(0,97)	(1,25)	(1,11)	-(0,14)	(0,97)	(2,92)	(1,94)	(0,83)	(1,39)	(0,56)
				[3,06]	[4,17]	[1,11]				[2,92]	[3,89]	[0,97]
6	321	331	**10**	533	547	**14**	374	349	**-25**	529	525	**-3**
	(0,42)	(0,28)	-(0,14)	(1,11)	(2,08)	(0,97)	(1,11)	(2,36)	(1,25)	(0,97)	(1,25)	(0,28)
				[4,58]	[4,86]	[0,28]				[2,36]	[3,75]	[1,39]
7	311	319	**8**	522	549	**27**	376	355	**-21**	531	524	**-7**
	(0,42)	(0,83)	(0,42)	(1,39)	(0,97)	-(0,42)	(1,39)	(0,97)	-(0,42)	(1,94)	(1,53)	-(0,42)
				[4,31]	[3,89]	-[0,42]				[3,61]	[5,00]	[1,39]
8	308	318	**9**	518	539	**22**	377	345	**-32**	534	529	**-5**
	(0,97)	(0,69)	-(0,28)	(2,08)	(2,22)	(0,14)	(2,08)	(2,36)	(0,28)	(1,67)	(2,92)	(1,25)
				[4,58]	[5,28]	[0,69]				[5,42]	[4,58]	-[0,83]
Mean	320	333	13	530	557	27	381	353	-28	537	526	-11
	(1,98)	(2,26)	(0,28)	(1,89)	(2,26)	(0,36)	(1,60)	(1,81)	(0,21)	(1,30)	(1,46)	(0,16)
				[4,24]	[4,76]	[0,52]				[3,73]	[3,84]	[0,10]

Table 4. Analysis of variance of Experiment 2.

Global Analysis

Mixed design: Task(BS) x SOA(BS) x Block(WS) x Cueing(WS)

Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
Task	1	10494151,00	68	52561,67	199,65	**0,0000**
SOA	1	59114,69	68	52561,67	1,12	0,2927
Block	7	9480,53	476	1524,43	6,22	**0,0000**
Cueing	1	24,33	68	1183,57	0,02	0,8864
Task x SOA	1	197439,61	68	52561,67	3,76	0,0568
Task x Block	7	821,12	476	1524,43	0,54	0,8053
SOA x Block	7	1795,12	476	1524,43	1,18	0,3140
Task x Cueing	1	16750,29	68	1183,57	14,15	**0,0004**
SOA x Cueing	1	110411,23	68	1183,57	93,29	**0,0000**
Block x Cueing	7	260,03	476	325,48	0,80	0,5885
Task x SOA x Block	7	559,71	476	1524,43	0,37	0,9212
Task x SOA x Cueing	1	281,56	68	1183,57	0,24	0,6273
Task x Block x Cueing	7	143,45	476	325,48	0,44	0,8764
SOA x Block x Cueing	7	1239,64	476	325,48	3,81	**0,0005**
Task x SOA x Block x Cueing	7	173,52	476	325,48	0,53	0,8095

Analysis of the data from the Short SOA

Mixed design: Task(BS) x Block(WS) x Cueing(WS)

Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
Task	1	6785226,00	34	53284,59	127,34	**0,0000**
Block	7	9159,79	238	1249,73	7,33	**0,0000**
Cueing	1	56856,81	34	1032,89	55,05	**0,0000**
Task x Block	7	459,87	238	1249,73	0,37	0,9203
Task x Cueing	1	6344,26	34	1032,89	6,14	**0,0183**
Block x Cueing	7	745,77	238	318,34	2,34	**0,0249**
Task x Session x Cueing	7	189,68	238	318,34	0,60	0,7591

Analysis of the data from the Long SOA

Mixed design: Task(BS) x Block(WS) x Cueing(WS)

Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
Task	1	3906364,50	34	51838,74	75,36	**0,0000**
Block	7	2115,87	238	1799,13	1,18	0,3172
Cueing	1	53578,75	34	1334,24	40,16	**0,0000**
Task x Block	7	920,95	238	1799,13	0,51	0,8252
Task x Cueing	1	10687,60	34	1334,24	8,01	**0,0078**
Block x Cueing	7	753,90	238	332,62	2,27	**0,0299**
Task x Session x Cueing	7	127,29	238	332,62	0,38	0,9120

Note: BS stands for Between Subjects and WS for Within Subjects.
Significant effects are shown in bold, marginally effects are underlined.

In the ANOVA performed on the data from the last four blocks of trials the facilitation effect was significant for both tasks ($p < 0.02$ and $p < 0.001$ for detection and discrimination, respectively), but did not change across blocks. This suggests that the decrease in the size of the cueing effect occurred during the first blocks of trials, and that little change occurred thereafter (see Figure 2).

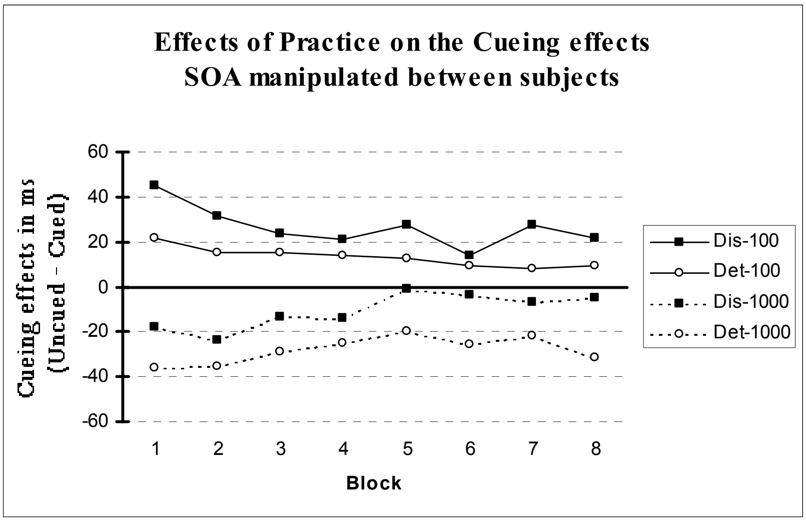

Figure 2. Results from Experiment 2. Mean cueing effects over 8 blocks of experimental trials and the practice block. Filled squares represent data from the detection task, and open circles represent data from the discrimination task. Full lines represent data from the 100 ms SOA, and broken lines represent data from the 1000 ms SOA.

In the analysis of the data from the *long SOA* groups there were significant main effects of Task and Cueing; and the Cueing x Task interaction was again significant. The cueing effect was negative (IOR) and significant in both detection (-28), $F(1, 34) = 42.02$, $MSerror = 1334.24$, $p < 0.0001$, and discrimination (-11), $F(1, 72) = 6.15$, $MSerror = 1334.24$, $p < 0.02$, but bigger in the former task. Again, the Block x Cueing interaction was significant, but not the three-way interaction ($F < 1$). In order to further analyze the practice effect on IOR, a different 2(Task) x 2(Cueing) x 4(Block) ANOVA was performed in the first and second halves of the experiment.

In the ANOVA performed on the data from the first four blocks of trials, the Block x Cueing did not reach significance; although it did when the data from the first 5 blocks were introduced into the ANOVA, $F(4, 136) = 2.90$, $MSerror = 341.15$, $p < 0.05$ (the three-way interaction was not significant). As can be seen in Figure 2, the cueing effect decreased significantly across blocks in both tasks; the linear component was significant, $F(1, 34) = 8.52$, $MSerror = 390.44$, $p < 0.01$, explaining 84.11% of the interaction. In the ANOVA performed on the data from the last four blocks of trials the Task x Cueing interaction was significant, $F(1, 34) = 9.02$, $MSerror = 831.17$, $p < 0.005$, as the IOR effect only was present in the detection task, $F(1, 34) = 26.15$, $MSerror = 831.17$, $p < 0.0001$ ($F < 1$ in the discrimination task). Furthermore, the Block x Cueing interaction was no longer significant, neither was the three-way interaction (both Fs < 1).

Analysis of Errors. Percentages of misses were analyzed with a mixed ANOVA that treated Task (2) and SOA (2) as a between subjects variable, and Block (7) [note 3] and Cueing (2) as within subjects variables. The main effect of Block was significant, $F(6, 408) = 3.47$, $MSerror = 5.38$, $p < 0.005$, as well as the Block x SOA interaction, $F(6, 408) = 2.85$, $MSerror = 5.38$, $p < 0.01$. In the early blocks of trials the target was missed more often in the short SOA than the long SOA, but the opposite was true in the later blocks.

The discrimination error rates were submitted to a mixed ANOVA, with SOA (2) as between subjects variables and Block (8) and Cueing (2) as within subjects variables. Only the main effect of Block was significant in the analysis, $F(7, 238) = 2.07$, $MSerror = 11.90$, $p < 0.05$. Subjects made more error in the first and last blocks, probably reflecting practice and fatigue effects.

DISCUSSION

In this experiment we clearly replicated the findings of the previous experiment (see Figure 2). The cueing effects were more positive (or less negative) in the discrimination task than in the detection task. Also, both facilitation and IOR decreased across blocks of trials. Three interesting results were observed. First, the facilitation effect of the short SOA was again reduced in both tasks. One important difference with the previous experiment is that here we also obtained a significant facilitatory effect in the detection task: The +22 ms facilitation obtained at the first block of trials was significant ($p < 0.02$), and, although decreasing with practice, it remained positive across blocks of trials. Therefore, both practice and temporal uncertainty seem to influence the cueing effects observed at short SOAs; with practice the facilitation effect is reduced and seems to disappear (or become negative), especially with temporal uncertainty. This result might explain previous failures to obtain facilitation in detection tasks (e.g., Riggio et al, 1998): in Riggio et al.'s experiments two or three SOAs were mixed within a block of trials.

Thus, it seems that temporal uncertainty (as in our Experiment 1) leads to a greater decrease with practice of the facilitation effect. Interestingly, this could explain why we did not obtain significant facilitation in the detection task in our first experiment: as we collapsed data from the first two blocks of trials in session 1, the effect could have disappeared by then. In fact, a closer analysis of the data from the first session of the detection task in the first experiment showed a significant facilitation effect that decreased quickly with practice [note 4].

Second, the IOR observed in the discrimination task with a 1000 ms SOA decreased significantly across blocks, as in the previous experiment. However, in this experiment without temporal uncertainty the effect was no longer significant after 420 trials ($F < 1$, in the analysis of the data from blocks 5-8). Compare the effect of the blocks 7-8 of Figure 2 with the effect of the session 4 in Figure 1. At this point, subjects had already performed 600 experimental trials in each experiment and, while in Experiment 1 (temporal uncertainty) there was still a -29 ms significant IOR effect, $F(1, 8) = 13.56$, $MSerror = 284.98$, $p < 0.01$, the -6 ms effect observed in Experiment 2 did not approach significance ($F < 1$).

Third, in this experiment, without temporal uncertainty, IOR decreased significantly also in the detection task: the effect in the last six blocks (-25 ms) was significantly smaller than the effect observed in the first two blocks of trials (-36 ms), $F(1, 17) = 6.09$, $MSerror = 244.11$, $p < 0.05$. It is interesting to note the size of the IOR observed in the practice block (-69 ms), which was significant, $F(1, 17) = 6.04$, $MSerror = 7090.13$, $p < 0.05$ (no such a decrease was observed in Experiment 1). Therefore, it seems quite clear that in Experiment 2 IOR also decreased in the detection task, thus replicating Weaver et al.'s (1998) results.

GENERAL DISCUSSION

The goal of the research reported in this paper was to study how practice can modulate the cueing effects observed at short (facilitation) and long (IOR) cue-target intervals. Weaver et al. (1998) showed a dramatic decrease in the IOR observed in static and moving displays. Thus this paper had two goals: First, to replicate their results, and second, to extend the study of practice effects on cueing to the facilitatory effect of short SOAs and to a discrimination task. We also wanted to see whether the IOR observed in discrimination tasks could nevertheless "survive" after many trials of practice (as it does in the detection task, according to Weaver et al., 1998, Experiment 2 with static displays).

We utilized the cueing procedure used by Lupiáñez et al. (1997) and different subjects performed a detection or a discrimination task. In our first experiment, a short and a long SOA were mixed within a block of trials (temporal uncertainty) and subjects performed the experiment 12 times on three consecutive days. The cueing effect of the 100 ms SOA was reduced with practice, and in the detection task became negative after 4 sessions. The IOR effect also decreased with practice but only in the discrimination task. In the discrimination task, although IOR decreased with practice, it remained significant after two thousand trials. In the second experiment, SOA was blocked (it was manipulated between subjects) so that there was no temporal uncertainty, and subjects performed one practice block and eight blocks of experimental trials in a single session. In this experiment all effects (facilitation and IOR, in detection and discrimination) decreased across blocks of trials. The IOR observed in the discrimination task disappeared after several hundred trials.

Several conclusions can be drawn from these results. We did not detect any decrease in the IOR observed in the detection task of our first experiment, where there was temporal uncertainty. Therefore, maybe the decrease in the magnitude of static-displays-IOR is not *always* as dramatic as Weaver et al. (1998) showed in their second experiment. Nevertheless, we replicated their results in our second experiment (and the discrimination task of the first experiment), and we showed that in some circumstances the decrease can be as dramatic as the decrease they showed in their first experiment with dynamic displays: This seems to be the case for the discrimination task in blocked SOA procedures, as in our second experiment.

Practice also has the same effect on the cueing results at short SOAs: The facilitation effect observed at short SOAs is dramatically reduced after a few trials. Importantly, the reduction of the effect is specially dramatic in the detection task, in which the effect seems to disappear (Exp. 2), or becomes negative (Exp. 1). This can easily explain some failures to find a facilitation effect in detection tasks (Riggio et al., 1998; Tassinari et al., 1994). Furthermore, the fact that the decrease in IOR across practice is accompanied by a decrease in facilitation refute the hypothesis that the decrease in IOR is due to a bolstering of facilitation. On the contrary, a habituation-to-the-cue hypothesis does a better job in explaining our data. According to this hypothesis both facilitation and IOR are reduced with practice because as subjects learn that the cue is unpredictive they habituate to it, thus reducing the attentional capture that it produces.

It has to be noted, however, that in a recent paper by Pratt and McAuliffe (1999) no significant reduction of IOR across practice is observed in three different experiments (a similar result to the one we obtained in the detection task of our first experiment). At present we don't have a clear explanation for Pratt and McAuliffe's result. In their experiments only a long SOA was used, as in our Experiment 2, so that temporal uncertainty cannot be the reason for not getting a reduction on IOR across practice.

On the other hand, our results are consistent with Lambert and Hockey (1991). Also using a detection task, in their first experiment they observed a significant facilitation effect in the two first blocks of experimental trials (after 10-15 practice trials) at 50 and 100 ms SOAs. However, this facilitatory effect had disappeared completely in the last two blocks of trials (only after 330 experimental trials). In their third experiment they manipulated the intensity of the cue and observed that with bright cues both IOR and facilitation effects decreased with practice (in fact the facilitation effect became negative). In contrast, with dim cues neither IOR nor facilitation effects were reduced. Therefore, brightness of the cue seems to be one of the variables that modulate the effect of practice on cueing. We also observed several differences between our first experiment in which the two SOAs were mixed within a block of trials, and the second, in which SOA was blocked. Thus, temporal uncertainty seems to be another variable that modulates the effect of practice.

Both brightness and temporal certainty of the cue might make it more salient. However, as the cue is unpredictive in these procedures habituation to the cue might be adaptive. The salience of the cue might lead to a greater need to habituate to it, thus leading to bigger practice effects on cueing. Alternatively, the easier to predict the cue and the more salient it is, the better job subjects might do in learning to avoid its attentional capture, thus leading to smaller cueing effects (both facilitation and IOR).

More research is necessary to determine the conditions under which cueing effects are affected by practice, the way they are affected, and the mechanisms by which practice affects cueing. Nevertheless, the present results provide important boundary conditions when drawing conclusions about the generality and robustness of the cueing effects observed in detection and discrimination tasks, and how they are affected by practice.

RESUMEN

Los efectos de la práctica sobre la señalización en tareas de detección y discriminación. En este artículo se presentan dos experimentos en los que se examinan los efectos de la práctica en la facilitación inicial y la posterior inhibición de retorno (IR) que se produce tras la señalización de un lugar, con tarea de detección y de discriminación de color. En el primer experimento se mezclaron dentro del mismo bloque de ensayos un SOA corto y otro largo, de forma que hubiera incertidumbre temporal. En el segundo experimento se manipuló el SOA entre grupos para eliminar la incertidumbre temporal. Tanto con tarea de detección como de discriminación, se obtuvieron respectivamente en los SOAs corto y largo efectos de facilitación e IR, los cuales se vieron reducidos consistentemente con la práctica. Los efectos de orientación atencional fueron en general más positivos (v.gr., mayor facilitación y menor IR) con tarea de discriminación que con detección. Los efectos de la orientación atencional y la práctica se vieron modulados por la incertidumbre temporal (Experimento 1 vs. Experimento 2). Nuestros resultados contribuyen en cierta medida a la resolución de algunos resultados contradictorios de la literatura experimental sobre los efectos de la práctica en la orientación atencional.

Palabras clave: Inhibición de Retorno (IR), facilitación, efectos de la práctica, atención espacial, orientación atencional, tareas de detección, tareas de discriminación.

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FOOTNOTES

Note 1: In this study, "about half of the subjects were unaware of the aim of the experiment" (Tassinari, et al., 1994, p. 181; emphasis added). The interesting implication of this statement is that about half of the subjects were aware of the aim of the experiment.

Note 2: Trials with RT < 100 ms represented 0.044%, and 0.150% of the correct response trials, for the short and long SOA respectively, in the detection task; they represented 0.000%, and 0.055% in the discrimination task. Trials with RT > 1200 ms represented 0.106% and 0.203%, respectively, in the detection task; they represented 1.171% and 0.558%, in the discrimination task.

Note 3: Because of a mistake in the program used to run the experiment, at the end of Block 2 subjects were shown a message informing them that the experiment had finished. Therefore they missed the target in the first trials of Block 3 (as it can be seen in Table 3, the miss rates in this block are higher than in Blocks 2 and 4). Because all subjects in a group participated in the experiment at the same time, this error could not be fixed after the first subject. To avoid contamination of the results, data from Block 3 were excluded from the analysis of misses. Note that this problem does not affect RT and discrimination error analyses.

Note 4: In this analysis we analyzed more precisely the data of the detection task of Experiment 1. Data from the short SOA of the practice block and the two blocks of experimental trials of the first session were introduced into a repeated measures ANOVA with Block (3), and Cueing (2) as within subjects variables. This analysis showed a significant main effect of both Block, $F(2, 16) = 3.83$, $MSerror = 5514.77$, $p < 0.05$, and Cueing, $F(1, 8) = 6.19$, $MSerror = 1139.81$, $p < 0.05$, and the Block X Cueing interaction, $F(2, 16) = 5.02$, $MSerror = 723.72$, $p < 0.05$. Therefore, the facilitation effect was significant, but decreased very quickly with practice (+55, +11, and +2 ms, for practice, first and second blocks of trials).

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