

PREPAREDNESS AND ELECTRODERMAL FEAR-CONDITIONING: ONTOGENETIC VS PHYLOGENETIC EXPLANATIONS

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Summary—In a review of existing theories of learning, Seligman (*Psychol. Rev.* 77, 406–418, 1970) suggested that humans should have an evolutionary derived preparedness to associate fear-relevant (e.g. snakes) events with aversive reinforcers. The preparedness hypothesis has been extensively tested by Öhman and his colleagues. One argument against a non-preparedness explanation for the Öhman findings has been that culturally aversive stimuli, like pictures of guns have not shown the same resistance towards extinction as pictures of snakes. However, the effect of pointing a gun *directly towards* the *S* vs pointing it *to the side* has not been tested. Therefore both slides of guns and snakes, directed both towards and aside from the subject, were used as conditioned stimuli (CSs) in the present study. A second question that has been discussed in the preparedness-literature is the *quality of the unconditioned stimulus* (UCS), i.e. if only shock can act as UCS for prepared CSs. Thus, both shock and noise UCSs were used in the present study. Skin conductance responses (SCRs) were recorded as dependent measures. The results showed conditioned acquisition, i.e. larger SCRs to CS+ than to CS–, in all groups except for the shock and noise UCS groups with the gun pointing aside as CS+ (where actually larger responses were observed to the CS–, i.e. the gun pointing towards). The extinction data showed significantly larger SCRs to CS+ than to CS– for both snakes and guns directed towards the *S*. Strongest resistance to extinction was observed for the group with the gun pointed towards as CS+ and with noise as UCS. The gun with noise as UCS pointed towards the *S* was not different from the snake with shock as UCS. Taken together, the results have shown three things; (a) directing a fear-relevant CS towards the *S* was a potent manipulation, and especially directing a gun with noise as UCS; (b) shock was overall not superior to noise as UCS, and especially not for snake CSs; (c) a weak form of unique belongingness was demonstrated.

In 1970, Seligman suggested that organisms have an evolutionary based preparedness to associate certain conditional stimuli (CSs) with certain unconditional stimuli (UCSs) (see also Seligman and Hager, 1972). As a consequence, the laws of learning and conditioning, emanating from the association between environmental events should not be applicable to the associative phenomena found in specific or simple phobias (Seligman, 1971). The assumption was empirically supported by studies on taste aversion (e.g. Garcia, McGowan and Green, 1972 for a review) where it was demonstrated that organisms more easily associated, for example, taste with illness than with electric shock. This was interpreted as that organisms were biologically prepared to associate taste with illness, and contraprepared to associate taste with shock. Other contingencies (e.g. tone and shock) were said to be unprepared (see also Öhman, 1979 for a review).

The introduction of the preparedness-hypothesis in 1970 by Seligman seemed to account for a number of characteristics of simple phobias that were unexplained by previous conditioning theories (see Eysenck, 1976, 1979; Marks, 1977; Rachman, 1976, 1977 for critical reviews). The characteristics mostly discussed were the similarities between phobic reactions and prepared conditioning in terms of: rapid acquisition (one-trial learning); slow extinction; and the non-cognitive mode of the reactions (Seligman and Hager, 1972; Öhman, 1979). Thus, the preparedness hypothesis could explain the selectivity and rapid acquisition seen in simple phobias. It could also explain why conditioned fear did not extinguish following unreinforced CS presentations. Finally it could account for the apparent “irrationality” found in phobic fears, i.e. the persistence of the fear despite cognitive awareness of the “innocuous” aspects of the situation (Marks, 1969).

Most of the empirical support for a connection between phobic fears and prepared conditioning have come from the studies performed by Öhman, Hugdahl and Fredrikson (e.g. Öhman, 1979, 1986; Öhman, Fredrikson, Hugdahl and Rimmø, 1976, Hugdahl and Öhman, 1977, Hugdahl,

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Fredrikson and Öhman, 1977; Fredrikson, Hugdahl and Öhman, 1976). The typical set-up of these experiments have involved a differential Pavlovian, or classical, conditioning paradigm. Different groups of non-fearful *Ss* have been exposed to fear-relevant (snakes and spiders) and fear-irrelevant (flowers and mushrooms) CSs with shock as UCS. Within each class of CSs, one stimulus (the CS+) is consistently paired with the UCS, where another stimulus (the CS-) is never paired with the UCS. Autonomic measures, typically skin conductance responses (SCRs) or heart-rate (HR) have been used as dependent variables. The basic findings may be summarized as follows: no differences in rate or degree of acquisition between fear-relevant (prepared) and fear-irrelevant (unprepared) stimuli (Öhman *et al.*, 1976); greater resistance to extinction to fear-relevant as compared with fear-irrelevant stimuli (Öhman *et al.*, 1976; Hugdahl and Öhman, 1977; Fredrikson *et al.*, 1976); instructions about the extinction procedure do immediately abolish responses to the fear-irrelevant CSs, but not to fear-relevant CSs (Hugdahl, 1978; Hugdahl and Öhman, 1977). Greater resistance to extinction occurred most frequently for the FAR-component (1–4 s after CS onset) of the SCR (cf. Lockhart, 1966).

The reported effects have been, at least to some extent, replicated by Siddle, Bond and Friswell (1987); Dawson, Schell and Banis (1986); Hodes, Cook and Lang (1985); and Cook, Hodes and Lang (1986), although there have been reports which have failed to replicate the basic effects (e.g. Merckelbach, van der Nolen and van den Hout, 1987; McNally and Foa, 1986; Maltzman and Boyd, 1984).

McNally (1987) concluded, however, after an extensive and thorough review of the existing empirical data up to 1987, that “the evidence most consistent with the theory (of preparedness) is the enhanced resistance to extinction of electrodermal responses established to fear-relevant stimuli” (p. 283). Thus, it may be argued that although the preparedness-explanation given by Öhman (1979; 1986) for the enhanced resistance effect to fear-relevant CSs have been supported from other laboratories, the issue of preparedness in human fear conditioning is far from settled.

Two aspects of the preparedness-hypothesis have recently come into focus: the ontogenetic vs phylogenetic basis for the enhanced extinction effect; and the effect of the unconditioned stimulus (see Öhman, 1986, McNally, 1987 for discussions). As argued by Öhman (1986), empirical reports have only shown that fear-relevant and fear-irrelevant CSs differ in rate of extinction, but these studies do not address the evolutionary hypothesis. One way to address this hypothesis would be to expose *Ss* to fear-relevant stimuli that are fear-relevant only in a cultural perspective. This has been done by Cook *et al.* (1986; see also Hodes, 1981). These researchers compared one group of *Ss* conditioned to slides of snakes and spiders (phylogenetic fear-relevance) with another group conditioned to handguns and rifles (ontogenetic fear-relevance). Significantly greater resistance to extinction was obtained in the snake-spider group (see also Hugdahl and Kärker, 1981 for a conceptually similar study). Thus, the results of the Cook *et al.* (1986) study argue against an ontogenetic basis for the enhanced extinction effect.

However, the effects of pointing a gun, or a rifle *directly towards* the *S*, vs pointing it *to the side* has not been systematically tested. It has been suggested in the literature that this might be crucial for refutation of an “ontogenetic explanation” for the prepared learning effect. It might further be argued that a picture of a snake looking directly towards the *S* should be more fear-relevant than a snake looking to the side, and especially so in conjunction with shock as the UCS. Interestingly, this was never systematically tested in the original experiments in the Uppsala-laboratory, nor have we seen that it has been tested in any other laboratory.

Thus, the first aim of the present study was to compare conditioning to pictures of snakes and weapons, directed both towards and aside from the *S*. It was predicted that a gun pointing directly towards the *S* might be more fear-relevant than pointing it aside. This might enhance resistance to extinction to guns to a level similar to that obtained for slides of snakes.

The second issue addressed, was a test that the basic resistance to extinction effect is specific for shock-UCSs. Both Hodes (1981) and Cook (1983) failed to demonstrate the extinction-effect with loud noise as the UCS. From this, Hodes (1981) concluded that it may be necessary to employ aversive tactile UCSs (like shock to the hand) because it better simulates snake bites than does noise. However, if this explanation is correct, then by the same logic, a loud noise would be a more effective UCS for conditioning to weapons, than would be a shock to the hand. Thus, the second purpose of the present study was to employ both shock and noise as UCSs.

METHOD

Subjects

The *Ss* were 80 students at the University of Bergen. There were 40 males and 40 females, and the corresponding age ranges were 19–40, and 20–41 yr, respectively. Participation was voluntary without financial reimbursement.

Apparatus

Skin conductance levels (SCLs) and responses (SCRs) were recorded on a Beckman 8-channel Type-R polygraph, with a Beckman 9844 skin conductance coupler. Beckman 8 mm dia Ag/AgCl-cup electrodes were used. The electrodes were filled with a 0.05 molar concentration of NaCl and UNIBASE (see Fowles *et al.*, 1982). Electric shock, serving as UCS for half of the *Ss*, were delivered from an inductive shock-generator charged by a manipulable stabilized d.c. current. Shocks were delivered with a frequency of 18 Hz. Shock duration was controlled from two Coulbourn precision adjustable one-shot timers and a Coulbourn OR-gate. 105 dB white noise, serving as UCS for the other half of the *Ss*, was generated from a Coulbourn noise-generator together with a Coulbourn OR-gate, and amplified by a NAD 3020B amplifier. Senheiser HD 425 headphones were used. Colour slides, serving as CSs, were back-projected from two Kodak Carousel S-AV 1000 projectors onto a 60 × 95 cm milk-glass screen inside the sound-attenuated chamber. The *S* was seated in a comfortable armchair inside the chamber.

The stimuli to be conditioned consisted of one set of guns ("cultural fear-relevance") and one set of snakes ("biological fear-relevance"). The objects on the slides were either directed *towards* or *aside* from the *S*. Each set consisted of two different slides in order to minimize the effect of irrelevant characteristics of the CSs.

Both CS duration, interstimulus intervals (ISIs), and intertrial intervals (ITIs) were controlled from Coulbourn universal timers. In order to achieve better control over the attack and decay times of the CS presentations, two Electronics Developments shutters were mounted on the lens of the projectors. The shutters were connected to Coulbourn universal timers, and to external shutter drivers.

Design

The basic design was a split-plot factorial (Kirk, 1968) $2 \times 2 \times 2 \times 2$ with *Stimuli* (weapons vs snakes) \times *Direction* (directed towards vs aside from the *S*) \times *Type of UCS* (shock vs noise) \times *Conditioning* (CS + vs CS -) as factors. The first three factors were treated as between-factors, while the fourth factor was treated as a within-factor with repeated measurements on each subject (Kirk, 1968). In the statistical analyses, a fifth factor, *Trials*, also with repeated measurements, was added.

Procedure

The *Ss* were randomly assigned to the eight different groups, depending on their order of appearance in the laboratory, with the same distribution of males and females in each group. After entering the laboratory the *Ss* were asked to sit down in an armchair in the sound-attenuated chamber, and await further instructions. Electrode sites were washed with distilled water, and the skin conductance electrodes were applied with the help of adhesive collars to the palmar side of the medial phalanx of the second and third fingers of the left hand. The *Ss* were instructed that they should be exposed to a series of slides on the screen in front of them, while bodily reactions were recorded.

For those *Ss* who had noise as UCS, the experimenter explained that they on some occasions during slide presentations would hear a relatively loud noise. For those *Ss* who had shock as UCS, the experimenter explained that they on some occasions during the slide presentations would receive a shock to the hand. The intensity of the shock was determined individually for each *S*. The experimenter gradually increased the voltage from below threshold, until the *S* reported that the shock was "uncomfortable but not painful".

All *Ss* were instructed to sit quietly during the experiment, and to watch the slides. Each CS picture was shown for 8 sec on each trial and immediately followed by shock or noise during the acquisition phase. The picture that was followed by UCS during acquisition was labelled CS+ and

the picture that was never followed by UCS was labelled CS-. Which picture that served as CS+ and CS- within each set of slides was counter-balanced across Ss. Thus, a differential conditioning procedure was used (cf. Prokasy and Kumpfer, 1973), with 8 sec ISI and the ITI varying randomly between 33 and 38 sec. The noise-UCS was administered manually by means of a switch. The duration of the noise was on the average 700 msec. The duration of shock was 200 msec. The slight difference in duration between noise and shock was imposed for technical reasons.

The general outline of the experiment followed the standard outline of the original Uppsala-experiments (see for example Öhman *et al.*, 1976). Thus, the first phase of the experiment was a habituation phase with only CS presentations. There were three trials each of the to-be CS+ and CS-, i.e. a total of six habituation trials. All presentations of CS+ and CS- in all phases were randomized. The second phase involved an acquisition phase, with 10 CS+/UCS presentations and 10 CS- presentations. In the third phase of the experiment, the CS+ and CS- slides were each presented for 20 trials. In order to avoid "sequence-effects", no more than two successive presentations of the same stimulus were allowed.

Response definitions

Phasic skin conductance responses (SCRs) were recorded in microSiemen (μ S). Only responses initiated 1–4 sec after CS onset were considered. Thus, First-Anticipatory-Responses (FARs) were scored, using the "Lockhart-criterion" (Lockhart, 1966). The use of FAR responses were motivated from previous results, since this component has been shown to be the most sensitive one (cf. Öhman *et al.*, 1976; Hugdahl and Öhman, 1977; Hugdahl, 1978). Only response-magnitudes in the range 0.05–2.0 μ S were considered. If more than one response occurred in the 1–4 sec window, the first one was scored.

Data analysis

All scores were subjected to analyses of variance (ANOVA), separate for each phase of the experiment. A rejection region of 0.05 was adopted for all comparisons between means. Follow-up tests for contrasts between means were performed with Tukey's HSD-test and the *t*-statistic.

RESULTS

Habituation

Mean SCRs during the habituation phase are seen in the left panels of Figs 1–4. There was a significant main-effect of Trials [$F(2,144) = 44.37$, $MS_{\text{Error}} = 0.022$, $P < 0.001$]. Figures 1–4

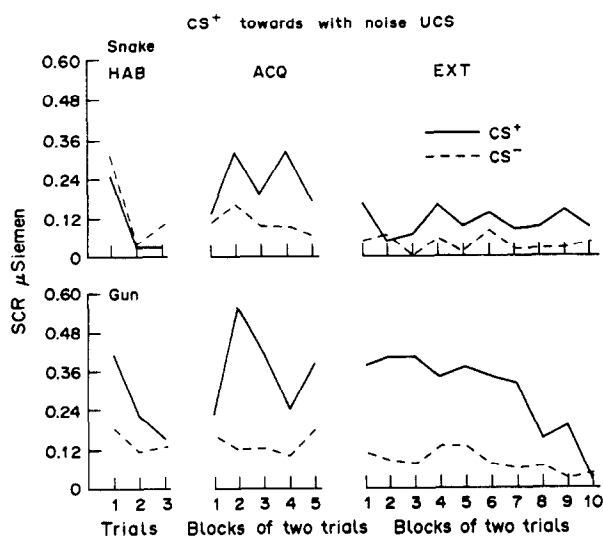


Fig. 1. Mean SCRs in μ Siemen for the three phases of the experiment as a function of trials for the two groups (snake; gun) with CS+ directed towards the S, and with noise as UCS.

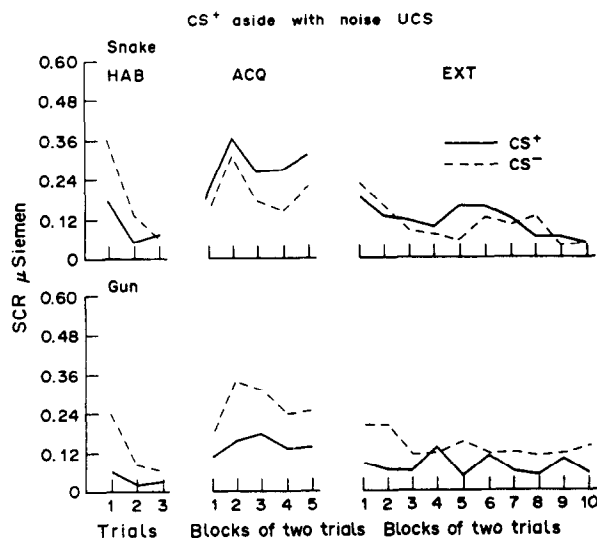


Fig. 2. As for Fig. 1, but for the two groups with CS+ directed aside from the S, and with noise as UCS.

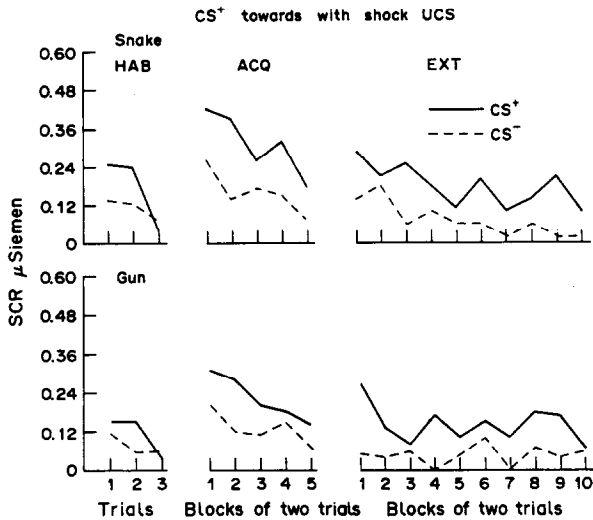


Fig. 3. As for Fig. 1, but for the two groups with CS+ directed *towards* the S, and with *shock* as UCS.

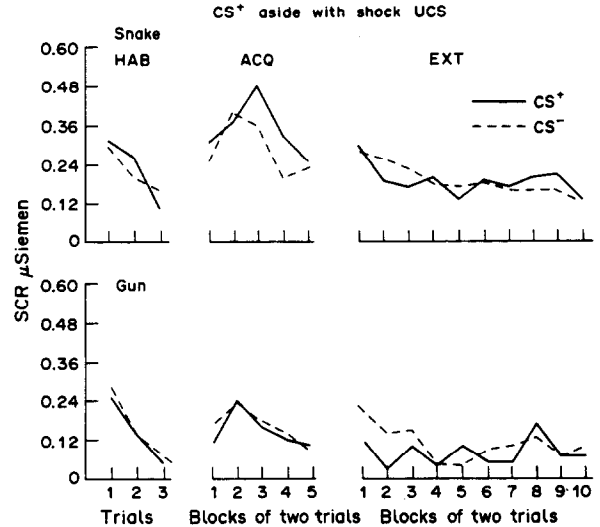


Fig. 4. As for Fig. 1, but for the two groups with CS+ directed *aside* from the S, and with *shock* as UCS.

indicate the effect to be due to decreasing response magnitudes across trials. Furthermore, the two-way interactions involving CS direction \times type of UCS, and CS direction \times conditioning were significant, [$F(1,72) = 5.30$, $MS_{\text{error}} = 0.108$, $P < 0.05$, and $F(1,72) = 5.35$, $MS_{\text{error}} = 0.029$, $P < 0.05$, respectively]. Figures 1–4 show that the interactions are due to differential initial responding in the different groups. No other sources were significant.

Acquisition

The acquisition results are shown in the middle panels of Figs 1–4. There was a significant main-effect of conditioning, [$F(1,72) = 29.89$, $MS_{\text{error}} = 0.112$, $P < 0.01$]. Follow-up tests with the t -statistic revealed significantly larger responding to the CS+ as compared to the CS– in all groups (all t -values > 1.74 , $P < 0.05$), except in the groups with the gun directed aside as CS+ (and consequently the gun directed towards as CS–). Responding to CS– was actually significantly larger than responding to the CS+ [$t(72) = 3.10$, $P < 0.01$] in the latter group. For the corresponding group with shock as UCS, responding was about equal to CS+ and CS– (see Fig. 4 and Table 1).

Thus, conditioned acquisition was demonstrated in all groups except in the two groups where the CS+ was the gun directed *aside*, and the CS– was directed *towards* the S.

Finally, the trials-factor was significant, [$F(9,648) = 4.25$, $MS_{\text{error}} = 0.068$, $P < 0.01$]. However, applying conservative Geisser-Greenhouse adjusted degrees of freedom, due to the inflated number of dfs in the nominator revealed the main effect of trials not to be significant.

In order to evaluate differences in *degree* of conditioned acquisition between the different groups, a separate three-factor ANOVA was performed on the mean (CS+)–(CS–) *difference score* for each S. The ANOVA was performed as a “completely randomized factorial” analysis (Kirk, 1968) with all three factors treated as between-factors. The factors were: CS content (snake vs gun) \times CS direction (towards vs aside) \times type of UCS (noise vs shock). Means for the difference-scores are

Table 1. Mean (CS+)–(CS–) difference scores during acquisition for the eight groups in the experiment

	Snake CS		Gun CS		Total
	Towards	Aside	Towards	Aside	
Noise-UCS	0.126	0.072	0.227	–0.121	0.076
Shock-UCS	0.152	0.068	0.092	–0.016	0.074
Total	0.139	0.082	0.160	–0.069	

Towards = CS+ directed towards the S. Aside = CS+ directed aside from the S.

seen in Table 1. The analysis showed a main effect of CS content [$F(1,72) = 4.56$, $MS_{\text{Error}} = 0.015$, $P < 0.05$] with overall larger responding to the snake CS+ compared to the gun CS+. This was mainly caused by the negative mean (CS+)-(CS-) difference in two of the "gun-groups" (see Table 1). There was, furthermore, a significant main effect of CS direction [$F(1,72) = 29.20$, $MS_{\text{Error}} = 0.015$, $P < 0.01$]. Table 1 reveals overall larger responding in the groups with the CS+ directed towards the *S*.

The two-way interaction of CS content \times CS direction was also significant [$F(1,72) = 8.34$, $MS_{\text{Error}} = 0.150$, $P < 0.01$]. The interaction was followed-up by pairwise comparisons with the *t*-static. This showed significantly better CS differentiation for the groups with CS+ directed towards the *S* compared with the groups with CS+ directed aside [$t(72) = 1.78$, $P < 0.05$] for the snake-towards vs snake-aside comparison, and [$t(72) = 5.89$, $P < 0.01$] for the gun-towards vs gun-aside comparison, respectively (see Table 1 for means).

Finally, the three-way interaction of CS content \times CS direction \times type of UCS was significant [$F(1,72) = 6.12$, $MS_{\text{Error}} = 0.015$, $P < 0.05$]. The three-way interaction was followed-up with the help of the *t*-statistic only for comparisons across the noise-UCS vs shock-UCS dimension for each CS content \times CS direction combination, since this was the theoretically most important aspect of the interaction. This revealed significantly larger conditioning in the Gun-Towards-Noise group compared with the Gun-Towards-Shock group, [$t(72) = 2.48$, $P < 0.01$], and significantly larger *negative* responding (i.e. larger responses to the CS- as compared with CS+) in the Gun-Aside-Noise group compared with the Gun-Aside-Shock group, [$t(72) = 1.90$, $P < 0.05$]. No significant effects were found for the corresponding comparisons for the snake groups.

A final comparison involved comparing (CS+)-(CS-) differential responding in the Gun-Towards-Noise group with the corresponding differentiation in the two Snake-Towards groups (see Table 1). These comparisons showed significantly larger differentiation in the Gun-Towards-Noise group in both comparisons, (all *ts* > 1.94 , $P < 0.05$).

To summarize the results for the acquisition phase, significantly larger responses were found to the CS+ compared with CS- (i.e. conditioned acquisition), except in the two Gun-Aside groups (see Figs 1-4 and Table 1). This means that in the two latter groups, directing the gun CS- towards the *S* was a more potent stimulus-attribute than the CS+/UCS contingency. Directing the CS+ towards the *S* yielded better conditioning than directing the CS+ aside from the *S*. This effect was valid for both snake and gun CSs. Furthermore, better conditioning was observed in the Gun-Towards-Noise group compared with the Gun-Towards-Shock group. No effect was seen in the corresponding snake comparison. Finally, conditioned acquisition was better in the group with the gun-CS directed towards the *S* and with noise as UCS compared with both the corresponding snake group and with the snake group having shock as UCS (see Table 1 for an overview).

Extinction

Mean SCRs for the different groups during the extinction phase are seen in the right-hand panels of Figs 1-4.

There was a significant main-effect of remaining conditioning with overall larger responses to CS+ compared with CS-, [$F(1,72) = 19.07$, $MS_{\text{Error}} = 0.116$, $P < 0.01$]. There was also a significant main-effect of trials, [$F(11,1368) = 3.55$, $MS_{\text{Error}} = 0.040$, $P < 0.05$]. Applying conservative Geisser-Greenhouse adjusted d.f.s showed however the effect not to be significant.

Furthermore, the two-way interaction of CS direction \times conditioning was significant [$F(1,72) = 35.64$, $MS_{\text{Error}} = 0.116$, $P < 0.001$]. Figures 1-4 indicate the interaction to be due to larger (CS+)-(CS-) differentiation in the groups with the CS+ directed towards the *S* as compared with the groups with the CS+ directed aside from the *S*. This was statistically evaluated by comparing mean responding to CS+ and CS- in the Towards- and Aside-groups, respectively. This showed significantly larger CS+ responses in the Towards-group, [$t(72) = 3.66$, $P < 0.01$], but not in the Aside-group, [$t(72) < 1$, NS].

Finally, the four-way interaction of CS content \times CS direction \times type of CS \times conditioning was significant, [$F(1,72) = 5.35$, $MS_{\text{Error}} = 0.116$, $P < 0.05$]. The most important aspect of the four-way interaction was the comparison (CS+) vs (CS-) for each of the eight groups. Figures 1-4 indicate larger mean responding to the CS+ in the four groups with the CS+ directed towards

Table 2. Mean (CS+) - (CS-) difference scores during extinction for the eight groups in the experiment

	Snake CS		Gun CS		
	Towards	Aside	Towards	Aside	Total
Noise-UCS	0.074	0.013	0.239	-0.049	0.069
Shock-UCS	0.108	0.014	0.096	-0.017	0.050
Total	0.091	0.013	0.168	-0.033	

Towards = CS+ directed towards the *S*. Aside = CS+ directed aside from the *S*.

the *S*, and larger mean responding to the CS- in the group Gun-Aside-Noise, and about equal mean responding to the CS+ and CS- in the other three groups. This was also confirmed in the follow-up tests [all $t(72)$ values > 2.03 , $P < 0.05$] for the CS+ towards groups, $t(72) = -1.82$, $P < 0.05$ for the Gun-Aside-Noise group, and no significant differences in the other three groups (all t -values < 1).

Since Figs 1-4 indicate greater resistance to extinction (i.e. greater (CS+) - (CS-) differentiation) in the Gun-Towards-Noise group compared with all other groups, a separate three-way ANOVA based on mean difference-scores with the factors; CS content \times CS direction \times type of UCS, was performed. All factors were treated as between-factors (Kirk, 1968), and the means are seen in Table 2.

This analysis revealed first of all a significant main-effect of CS direction [$F(1,72) = 31.71$, $MS_{\text{error}} = 0.012$, $P < 0.01$]. As seen in Table 2, the effect was due to significantly larger responding in the groups with the CS+ directed towards the *S*. Furthermore, the two-way interaction of CS content \times CS direction was significant [$F(1,72) = 6.24$, $MS_{\text{error}} = 0.012$, $P < 0.05$]. This was due to significantly larger response differentiation in the Gun-Towards combination [$t(72) = 3.11$, $P < 0.01$], but not in the corresponding Snake-combinations [$t(72) < 1$].

Finally, the three-way interaction of CS content \times CS direction \times type of UCS was significant [$F(1,72) = 4.44$, $MS_{\text{error}} = 0.02$, $P < 0.05$]. In order to appropriately evaluate the three-way interaction, and the apparent larger response-differentiation observed in the Gun-Towards-Noise group compared with all the other groups (see Table 2), the three-way interaction was followed-up with Tukey's HSD-test (Kirk, 1986). Differences between means for the Tukey-analysis are seen in Table 3.

As can be seen in Table 3, the Gun-Towards-Noise group was superior to all other groups, except for the Snake-Towards-Shock group. The Snake-Towards-Shock group was however not superior to any other combination, except for the Gun-Aside-Noise combination (see Table 3).

To summarize the most important extinction results, superior responding to CS+ compared to CS- was observed only in the groups where the CS+ was directed towards the *S*, while superior responding to the CS- was observed in the group where the *gun* CS- was directed towards the

Table 3. Differences between means used in the HSD-analysis for the eight groups during extinction

		Snake CS				Gun CS			
		Towards		Aside		Towards		Aside	
		noise	shock	noise	shock	noise	shock	noise	shock
S N A K E	noise	—	-0.034	0.061	0.060	-0.165*	-0.022	0.123	0.091
	Towards								
	shock		—	0.095	0.094	-0.131	0.012	0.156*	0.125
	noise			—	0.001	-0.226*	0.083	0.062	0.029
G U N	Aside								
	shock				—	-0.225*	-0.082	0.035	0.030
	noise					—	0.152*	0.287*	0.255*
	Towards								
G U N	shock						—	0.145	0.112
	noise							—	-0.031
	Aside								
	shock								—

HSD (05,72) = 0.153; * = $P < 0.05$.

Towards = CS+ directed towards the *S*. Aside = CS+ directed aside from the *S*. The matrix should be read as the vertical mean minus the horizontal mean.

S. Moreover, superior resistance to extinction was observed in the group with the gun directed towards the S as CS+ and with noise as UCS, compared to all the other groups (except for the Snake-Towards-Shock group).

DISCUSSION

The following conclusions seem warranted:

(1) Supposedly *phylogenetic* fear-relevant CSs (snakes) do not yield better conditioning than *ontogenetic* fear-relevant CSs (guns).

(2) A slide with a gun *pointing towards* the S as CS+ was the far most potent CS+, and especially in conjunction with noise-UCS. However, as seen in Table 3, the Gun-Towards-Noise group was not significantly different from the Snake-Towards-Shock group. Thus, one might cautiously argue that a weak form of belongingness between Snake CSs and Shock on the one hand, and Gun CSs and noise on the other hand has been demonstrated. The reason why this conclusion is stated in a cautious way is that the Snake-Towards-Shock group was *not* superior in any other important comparison. Thus, the argument of unique belongingness is only given "passive" empirical support in the present study (failure of a difference).

(3) *Shock-UCS* did overall not yield superior acquisition and resistance to extinction compared with noise-UCS for the snake CS groups. However, *noise-UCS* yielded both superior acquisition and superior resistance to extinction for the gun CS groups. Thus, in this context, the present results do not support the data presented by Cook *et al.* (1986) and the interpretation given by Öhman (1986) of a unique belongingness between snakes (and spiders) and tactile UCSs (like shock).

(4) Previous results with handguns as CSs (reviewed in Öhman, 1986) which have *not* shown such CSs to be as effective conditioned stimuli as supposedly phylogenetic ones (like snakes and spiders), might have confounded the direction of the guns.

The present study was a comparison of two different fear-relevant CSs, one supposedly phylogenetic (snakes) and one clearly ontogenetic (guns) in origin. Thus, the present study *did not* address the issue of superior acquisition and/or resistance to extinction for fear-relevant vs fear-irrelevant CSs. This is important to keep in mind, since the present results cannot, and should not, be related to the problem of whether fear-relevant CSs in themselves are more potent as conditioned stimuli than fear-irrelevant CSs (see McNally, 1986 for a review of this problem, see also Öhman, 1986).

The rather dramatic effect of pointing the gun towards compared with pointing it aside from the S has an interesting parallel in the preparedness-literature where facial expressions have been used as CSs. In a first study, Öhman and Dimberg (1978) demonstrated that slides of angry facial expressions as CS+ yielded superior conditioning than slides of happy facial expressions. However, in a second study (Dimberg and Öhman, 1983) it was found that the extinction effect for the angry facial display was present *only* when the angry face was glaring directly at the subject. When the face was looking aside from the S, SCRs extinguished rather immediately after shock cessation.

The prediction that a shock-UCS would be more effective with snake CSs, since it "simulates" a snake-bite (cf. Hodes, 1981), and that a noise-UCS would be more effective with gun CSs, since it "simulates" the sound of firing the gun, was "actively" supported only for the gun-noise association since no difference was observed between noise and shock-UCSs for the snake CS, nor during acquisition neither during extinction (cf. conclusion 2).

It may be interesting to note that previous studies aiming at the phylogenetic vs ontogenetic explanation for the preparedness effect (Hodes, 1981; Hugdahl and Kärker, 1981) did not involve the appropriate CS content \times type of UCS comparison. Hodes (1981) compared biologically fair-relevant CSs (snakes and spiders), culturally fear-relevant CSs (guns), and neutral CSs (flowers and mushrooms), but with noise as UCS in all conditions. Hugdahl and Kärker (1981), on the other hand, used shock as UCS when comparing biologically fear-relevant with culturally fear-relevant (electric outlets) CSs. The only study, at least to our knowledge, that have involved both noise and shock UCSs in the same study is the study by Cook *et al.* (1986). However, Cook *et al.* did not compare biologically with culturally fear-relevant CSs.

Different authors have argued that the so-called "superior resistance to extinction-effect" found to slides of snakes and spiders may reflect ontogenetic (i.e. cultural) influences rather than

phylogenetic (biological) influences (e.g. Bandura, 1977; Delprato, 1980, see also McNally, 1987). The present study has shown that cultural fear-relevant CSs (slides of a gun) may be more potent conditioned stimuli than biological fear-relevant CSs *if they are directly pointing towards the subject*, i.e. when they are experienced as possibly threatening. Furthermore, while the UCS-manipulation was important for the gun CSs, no difference between noise vs shock UCSs was seen for the snake CS. Thus, the results of the present study qualify previous statements that slides of guns and rifles are not as potent CSs as snakes and spiders, and the present results do not support the argument that tactile UCSs are more effective for snake and spider CSs because they "better simulates snake and spider bites than does a loud noise" (McNally, 1987, p. 290).

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