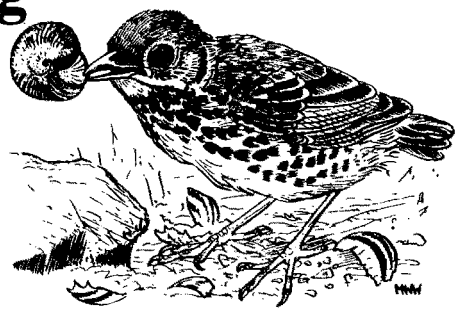
Development of snail-smashing by Song Thrushes



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The note on snail-smashing by a previously inexperienced Song Thrush *Turdus philomelos* (Herring 1984) prompted me to summarise some observations made on hand-reared birds, mostly during 1961, as part of my doctorate project (Henty 1965), but not otherwise published previously.

Experimental methods

The idea was to present some individuals of a brood with hard objects, including snails (adults of the medium-sized brown *Arianta arbustorum*), and follow how their behaviour developed day by day until a snail had been smashed. One or more of the others in the brood which had also been given similar spells in the test situation, but no access to any hard objects, were then given snails in order to see whether preliminary 'practice' really was necessary or whether the naïve birds could (at the right age) smash a snail in spite of having had no previous relevant experience.

Some initial tests had shown that newly fledged Song Thrushes presented with small flattish pebbles and spills of wood would perform the typical smashing behaviour. In the main experiments, therefore, a third type of early experience was studied by giving some birds these objects, but no snails: a type of partial deprivation. Throughout the period of the main experiments, the thrushes were kept together in broods in canary cages, with a wire floor so that dried faecal pellets were not accessible as hard objects. Similarly, the food was inspected, and berries or hard lumps removed. By opening a sliding partition, the bird chosen for a test could be gently ushered into a test cage which had a floor of soft sacking folded several times. Besides the appropriate test items, the test cage also had permanent furniture consisting of four units: two were hard 'anvils' made from tiles of the same area (6 × 6 cm) but of different heights (1.1 cm and 2.5 cm, though this turned out to be unimportant). I was interested in how thrushes might develop the recognition of anvils, so included two soft 'anvils' made from sacking, but mimicking the hard anvils in size and colour. The positions of all four were varied amongst tests at random. Usually, a particular bird would have two tests per day, but the exact

number depended on circumstances. A bird's response was quite self-determined and was very unpredictable. If no response occurred within five minutes, a test was ended; if there was some smashing behaviour, a test ended when 30 seconds elapsed without response. The naïve birds were given five-minute tests with anvils, but no objects. Due to hand-rearing, the young thrushes were quite tame, so I made records seated in full view. Initially, I used a tape recorder, but soon developed a shorthand system that noted every occurrence of the behaviour types mentioned below.

Basic responses and their development over time

Snails, pebbles and wood spills were all treated in a similar fashion. Simple pecking was quite common; alternatively, the bird would grip the object and then lift it. Often, the object was then just carried or dropped immediately, but otherwise it might be flicked (in mid air, bird in normal standing position) or actually hit on the ground by lowering the head and crouching slightly. Rarely, a hard, snail-sized object was shaken in mid air or vibrated on the ground. Testing was started when a brood showed consistent exploratory pecking, eight or nine days after fledging. The three birds whose tests included snails took nine, 24 and 25 days before a snail was broken; four more individuals in less-well-controlled pilot experiments the year before (1960) took 15 to 22 days. A major reason for the slow development is that, given a choice, much of the early smashing behaviour is directed to the pebbles and wood spills which are more easy to grip and lift. Thus, the thrushes largely develop an efficient response with inanimate objects in 13 days or less, and eventually transfer this to snails. The primary development of smashing behaviour is similar for birds given hard objects, whether or not snails are included; this section uses information from all such birds. The general level of interest in hard objects can be measured by taking pecking and lifting together, and this does not vary systematically from day to day. Lifting, however, steadily replaces pecking as the main initial response, rising on average from 35% to 60%. Once lifted, the number of smashing responses performed before the object is dropped rises steadily, from 1 to 4.5 just before a snail is actually broken. At the start, flicking is the main response compared with hits (at 51%), but hits steadily become the dominant behaviour, ending at 94%. Few of the early hits (6%) are directed to the hard anvils, but this rises to a mean of 66%. Thus, over a period of one to two weeks, the choice and persistence of relevant responses changes in at least four ways, so that, finally, a snail would be very likely to be broken if it were to be chosen as an object of attention. Two observations on newly fledged wild thrushes suggest that the artificial situation is not misleading. C. S. Elton FRS (*in litt.*) saw a large *Helix aspersa* being hit but not smashed, whilst G. Lewis (*in litt.*) noted smashing behaviour being applied to the split and almost empty husks of the conkers of horse chestnut *Aesculus hippocastanum*. These seem to be the only developmental observations on young thrushes in the wild.

Behaviour of naïve birds at first test

The changes with time, described above, naturally suggest, but do not

prove, that a young Song Thrush needs extensive practice before being able to smash snails. The critical test, however, is the response of their brood mates that have not had such practice. Three such naïve birds were presented only with a snail, and all succeeded in breaking it first time, as did a bird in the pilot experiment whose environment was not so well screened for accidental objects. Another naïve individual was tested with snail, pebble and wood spill, and directed most of its response to the pebble, so that, although its behaviour was well organised, it did not break a snail first time, but only in another test when undistracted by other objects.

Thus, the supposed practice is not in fact essential. The inexperienced birds are, however, not exactly the same, since only 35% of their hits are directed to the hard anvils ($P = 0.012$, Mann Whitney) and they show more of the ineffective flicks, though this is not statistically reliable. There are strong indications that some of the fledglings learn to use the hard anvils during the course of their very first test. When tested with inedible hard objects, these birds initially responded vigorously, but the response rapidly wanes. It seems that a few rewarded performances with real snails enables Song Thrushes quickly to ignore other hittable objects. Interestingly enough, the results from the group with partial deprivation show that extensive experience with pebbles and wood spills inhibits first response to a snail–the general level of smashing behaviour has become depressed–and several tests with snails are needed before the response recovers sufficiently to be effective. Even after young thrushes have smashed and eaten many snails, they will respond to novel hard objects of the right size, for example a collar stud or a wood spill painted a new colour; this interest is, however, very shortlived.

Other observations

I did a few tests to determine the stimulus characteristics that elicit smashing responses. Broken shells are hit in the normal way, but small pieces of shell are mandibulated, as are large pieces of india-rubber and mealworms. A floppy piece of fabric several centimetres square was shaken. Thus, to be treated as a snail, an object has to be both hard and of a certain size (probably too large to be swallowed whole). One young thrush which had suffered a severe gut infection, associated with white panels in its flight feathers, showed a most aberrant response. It ignored hard objects, but, after having eaten mealworms normally for 16 days, it suddenly started to smash them for up to 15 minutes at a time, so that the prey was reduced to a shred of chitin. After three days, it started to hit the mealworm on the hard anvils, and the next day pecked at and occasionally lifted a snail whilst it was carrying a mealworm. In the next test, it broke and ate a snail, and never smashed mealworms again. In this case, the behavioural actions were normal, but the selection of objects highly unusual.

Discussion, and the responses of Blackbirds

In his note, Herring (1984) described a case very similar to my naïve birds, but did imply that social example is the only relevant previous experience. This overlooks the possible role of individual trial-and-error. My

experiments showed, in fact, that practice has only a marginal effect, but it could well be that the noticeable pecking and pulling at anvils and other cage fixtures gives a bird information about the relative hardness of the substrate which could help direct the response when first tested with a snail. Similarly, the general use of the bill in feeding and exploratory pecking could help a bird to direct its bill to the lip of a snail, which the naïves did just as well as more experienced individuals. It should be noted that the observations of Haviland & Pitt (1919) are quite consistent with my results for 'experienced' birds, but their conclusion that learning must be involved is just not tenable on logical grounds.

I made some tests with three young Blackbirds *T. merula*, which showed all the responses of the Song Thrushes, but only as isolated, non-persistent, actions (except for pecking, which was by far the major reaction to a pebble or an intact snail). The Blackbirds readily swallowed the bodies of snails removed from their shells, and with half-broken shells lifted them and got at much of the body through a combination of hits, flicks and shakes. Snails with 5-mm to 10-mm diameter holes in the shell that exposed the body were mainly pecked, with rare bouts of hitting, so that, although after a long time most of the body had been eaten, the original hole had not been obviously enlarged. Interspersed tests with intact, crawling snails showed that the Blackbirds still only pecked at them briefly. Two of the Blackbirds were later kept together with Song Thrushes that were breaking snails. The Blackbirds watched and would rob the thrushes, but this did not alter their own response to intact snails. Basically, Blackbirds have the appropriate repertoire of actions, but do not persevere and link hits into sequences that are long enough to be effective.

There are—very rarely—reports of Blackbirds breaking snails (Butlin 1959; Vere-Benson 1963), but very few species apart from the Song Thrush regularly do it, even though it is apparently a good source of food, available in drought and frost. Exceptions to this are the Himalayan *Myiophoneus caeruleus* and Malabar Whistling Thrushes *M. horsfieldi* (Sálim Ali 1949, 1953), a bower bird, the Tooth-billed Catbird *Scenopoeetes dentirostris* (Marshall 1954), and the Noisy Pitta *Pitta versicolor* (Cayley 1959). There is no reason to suppose that breaking snails imposes any special limitation on the Song Thrush, since no marked morphological specialisation is involved. There could possibly be some other form of disadvantage to explain why so few species have evolved an apparently simple behavioural performance. In nature, the sound of a thrush breaking a snail can be heard for some distance, and in many woods there are very few anvils, so a bird must return regularly to a small number of sites. This could make Song Thrushes more detectable by predators, and more easily ambushed. Morris (1954) noted that a pair of Song Thrushes used anvils remote from the nest whilst the young were there: this suggests that predators may be attracted to anvils. Both in England and on the Continent, there is some evidence that Song Thrushes are caught by Sparrowhawks *Accipiter nisus* more readily than are Blackbirds (Owen 1932; Tinbergen 1946). The evidence is thin, but at least consistent with selection pressures being exerted by nest-predators and other predators on birds that break snails by hitting them on anvils.

This study also highlights the inadequacy of calling types of behaviour 'innate' or 'learnt'. The basic actions do not depend on practice, nor the selection of hard objects, but there is reason to suppose that experience plays a role in the selection of hard anvils, whilst the final discrimination of snails seems to be a case of operant (as distinct from Pavlovian) learning being guided by food reward. Thus, in the normal development of snail-smashing by Song Thrushes, there is an interplay of inherent influences with influences of traditional learning. Lorenz's idea (1966) of the 'innate school marm' seems appropriate in this example: any animal that innately picks up large hard objects in the environment, perseveratively (repeatedly) hits them on the ground, prefers the feedback from hard surfaces, and prefers doing the behaviour to items that provide food, is inevitably going to be a self-taught breaker of snails.

My thrushes were then engaged in hunting for snails in an aviary, and were afterwards released into the wild.

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Summary

This paper describes and interprets observations, made in 1961, of young Song Thrushes *Turdus philomelos* in controlled conditions, to study the mechanism of the development of the species' habit of breaking open snail shells by smashing them against a hard object ('anvil'). Fledglings gradually develop an effective performance when given repeated tests with snails. Naïve individuals, however, that have never seen any suitable hard objects, will nevertheless break a snail the first time if this test occurs several weeks after fledging.

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