Effect of Rearing Environment and Environmental Enrichment on the Behavior of Neural Development of Young Pigs

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Introduction

There has been increasing societal concern about the welfare of farm animals residing in certain modern systems which provide less varied sensory input than natural surroundings (Harrison, 1964; Singer, 1976; Hason and Singer, 1980; Fox, 1984). Environmental complexity affects both central nervous system anatomical development and behavior (Bennett et al., 1964; Diamond et al., 1964; Greenough and Chang, 1985). Barren environments which restrict sensory input in terms of quantity, quality, or variety tend to increase both behavioral and central nervous system excitability. One question is: Do farm animals residing in these systems have symptoms of sensory restriction? Another is: Will simple, inexpensive methods of environmental enrichment such as objects or extra contact with people have beneficial effects on the animals' well-being? One aim of the research reported in this thesis was to answer these and other questions as they pertain to the pig.

A second aim was to determine if environmental enrichment would have beneficial effects on productivity and handling behavior. Animals which move easily during handling at the meat packing plant will be less likely to get bruised or have stress induced meat quality problems.

A third aim was to quantify the pig's interactions with environmental enrichment objects and determine if environmental enrichment would reduce fighting in newly mixed pigs.

Summary of Results and Conclusions

Dendritic growth in somatosensory region of brain cortex in pigs residing in a simple or a complex environment.

Rearing environment had a significant effect in dendritic growth and soma size in the somatosensory cortex of young pigs. It had no effect on these parameters in the visual cortex. Pigs residing in pairs in small barren indoor pens (simple environment, SE) had greater dendritic growth and larger somas than 12 pigs living together in a large outdoor pen with straw, play objects, and positive daily contact with a person (complex environment, CE).

The pigs in the SE engaged in greater amounts of belly nosing compared to the CE pigs. The CE pigs had greater overall rooting activity toward a variety of objects, but 95% of that activity was directed toward objects. Even though the SE pigs had less overall rooting activity, only some 4O % of their rooting was directed at objects, and approximately 60% of the time was spent rooting on the other pig. Casual observations indicated that the SE pigs were more excitable and aggressive toward the experimenter than the CE pigs.

Environmental enrichment reduces excitability in pigs

Experiment I

Environmental enrichment reduced excitability in young weanling pigs which resided in small barren pens. Control pigs were rated more excitable than pigs which had continuous access to hanging cloth strips or 5 mm of daily petting from a person. Pigs which had two environmental enrichment treatments were rated less excitable than pigs which had only one.

Experiment II

Smaller amounts of environmental enrichment also reduced excitability in older finishing pigs. Controls were rated more excitable than animals which received continuous access to hanging rubber hoses, 5 min. of weekly petting from a person, or a weekly drive in the aisle. A combination of environmental enrichment treatments was more effective than a single treatment. Environmental enrichment treatments had no effect on weight gain.

Environmental effects on ease of handling

In Trial 1, environmental enrichment treatments reduced the force required to move finishing pigs through a single-file chute. The treatments were continuous access to hanging rubber hose objects (objects), gentle petting for 10 min weekly (mingle), weekly drives In the aisle (drive) or a combination of these treatments. In Trial 2, control pigs required the least amount of force to drive them through the chute.

Trial 2 pigs were calmer and tamer at the start of the trial compared to Trial 1 pigs. There may be an optimum level of handling and contact which will produce a calm market animal that is easy to drive, but not so tame that driving becomes difficult. Trial 2 controls were calm and tame due to a change in farrowing house manager between trials and increased pen washing in

Trial 2. Pen washing is a form of handling, and in this case it served to tame the controls. Trial 2 control pigs were further tamed by the new farrowing house manager. Pigs in the mingle treatment in Trial 2 became so tame that they refused to move through the chute. Control pigs in Trial 1 were excessively excitable, which made driving more difficult. In conclusion, for animals that will be marketed for slaughter, it is desirable to have a calm animal that is easy to drive, but not so tame that driving is difficult.

Object interaction in weanling pigs

Experiment I

A short-term 15-min. preference test indicated that weanling pigs prefer suspended cloth strips. Chain was the least preferred object. In three trials, duration of touching and duration of biting indicated that pigs preferred cloth objects. Duration of touching and biting of hanging rubber hoses was reduced because the pigs had difficulty grabbing them with their mouths.

Experiment II

A short-term 15-min. preference test similar to Experiment I indicated that pigs had individual preferences for different cloth textures. In general, there were no group preferences but there were distinct individual preferences.

Experiment III

Chewing and pulling suspended cloth objects decreased over a period of 3 weeks from an average of approximately 1 hour to 20 to 30 minutes. Even though play decreased, the pigs still actively played with the cloth strips at the end of the trial.

Experiment IV

Object interactions had a tendency to increase when the pigs most active. Play and fighting both occurred more often the pigs were standing or eating.

Experiment V

A 7-day preference test indicated that object preferences changed over the time. For the first three days of the experiment, cloth objects were preferred. At the end of the day period, however, hanging rubber hoses were preferred. Hanging chains were the least preferred objects all along. The change from cloth to hose preference may be due to the developrnent of motor coordination. Observations showed that small pigs often had difficulty grabbing the hose until they had had some experience with it.

Experiment VI

The presence of hanging cloth strips during regrouping reduced the number of 5-min. periods which contained fiqhting. The presence or absence of hanging cloth objects for seven days prior to regrouping had no effect on fighting. Providing hanging cloth strips for seven days prior to regrouping reduced chewing and pulling of the strips during the 24-hour regrouping period.

General Conclusions

Rearing environment has strong effects on both the central nervous system and pig behavior. Small amounts of environmental enrichment reduced excitability and fighting. The provision of hanging cloth strips during regrouping of young pigs reduced fighting. Suspended objects and small amounts of contact with a person in the pen also reduced excitability.

Environmental enrichment uniformly reduced excitability in all the experiments, but it affected behavior during handling in a complex manner. There may be an optimum level of contact with people for animals which will be marketed for slaughter. Both excessively excitable and overly tame animals are difficult to drive and handle. In one trial, regrouping and objects reduced the force required to drive pigs through a single file chute.

But, in a second trial, the controls were easiest to drive. In Trial 2, the pigs in the mingle group were overly tame and thus difficult to drive. The recommended amount of environmental enrichment for finishing pigs will vary depending on genetics and the animals' previous experiences. Management procedures which make pigs more amenable to handling at the slaughter plant would help prevent costly bruises. They also would help improve meat quality because excitement in the stunning chute increases PSE and other meat quality problems (Barton-Gade, 1985; Grandin, 1986).

There has been increasing societal concern about the welfare of farm animals residing in certain modern systems which provide less varied sensory input than natural surroundings (Harrison, 1964; Singer, 1976; Mason and Singer, 1980; Fox, 1984). Some pigs kept in barren pens on modern farms may be exhibiting symptoms of sensory restriction. The animals are excitable, as may be judged, for example, by their jumping up suddenly when a door slams.

Excitability and increased irritability is a symptom of sensory restriction. Pairs of puppies residing in barren kennels become unusually aroused and excited when exposed to something new (Melzack, 1954), Environmental restriction may have longterm detrimental effects on the central nervous system. The young dogs still had abnormal electroencephalographic patterns 6 months after being removed from the barren kennel (Heizack and Burns, 1965). Animals living in an enriched environment are usually less excitable than animals in barren surroundings (Walsh and Cummins, 1975).

The experiments on dendritic branching and soma size in young pigs indicate that rearing environment has significant effects on nervous system development. The results were contrary to the original hypothesis that animals in the enriched environment (complex environment, CE) would have greater dendritic branching. Volkinar and Greenough (1972) found that rats residing in an enriched environment with objects and other rats had more dendritic branching in the visual cortex compared to pairs or isolates in plain cages.

Pigs reared in the simple environment (SE) had greater dendritic branching in the somatosensory cortex. There were no significant differences in dendritic growth in the visual cortex.

The behavior of the SE pigs differed significantly from the CE pigs. The SE pigs engaged in greater amounts of belly nosing. Increased belly nosing may have stimulated the somatosensory cortex. As the environment is made increasingly barren, nibbling and massaging of other pigs will increase (Stolba, 1981). The SE pigs also were more excitable and aggressive toward the experimenter.

Rearing environment affects dendritic development in complex ways. More dendritic development Is not necessarily beneficial. Monkeys reared in the colony had less dendritic branching in the Motor 1 cortex compared to isolates in a cage with ladders and swings (Stell and Riesen, 1987). Rats exposed to continuous lighting had greater spine Gensity in the visual cortex but their retinas were damaged (Parnavelas et al. 1973; Bennett et al., 1972; O7Steen, 1970).

Pigs in the SE condition appeared to be actively seeking stimulation. Walsh and Cummins (1975) state that an organism becomes increasingly sensitized to stimulation in an attempt to restore balance. Lack of normal sensory input causes the areas of the brain that receive sensory input to become more excitable. Trimming the whiskers of baby rats causes the receptive field in the brain to become more excitable and enlarged (Simons and Land, 1987). The receptive fields were still enlarged three months after the whiskers had regrown.

Increased belly nosing may have been an attempt to obtain more stimulation and reduce arousal. The SE condition was more barren than any environment which would exist in nature. Perhaps the SE environment deprived the animals beyond their ability to cope. The increased dendritic branching in the somatosensory cortex of the SE pigs may be highly abnormal.

Experimental results indicate that simple and inexpensive environmental enrichment procedures such as suspended cloth strips or hoses and small amounts of increased positive contact with people will reduce both excitability and fighting in young pigs. Reducing excitability is advantageous for animal we1fare reasons. Excessive excitability may be a sign of detrimental effects of sensory restriction in the nervous system.