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Choice tests; application and relevance in terms of improving husbandry methods and welfare of captive animals

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Abstract

Choice tests have been widely used across numerous species for a variety of reasons, including environmental enrichment preference, food and its presentation, enclosure and enclosure furniture preference, and mate choice. Choice tests can entail a cost to the animal, for example by making it work for access to a resource. The harder an animal is willing to work for a resource, or the higher the price it is willing to pay for it can reflect the importance of that particular resource to that individual. The use of choice tests can be useful in establishing what an animal wants or prefers and have the potential to positively impact an individuals' welfare, improve husbandry methods and expand on scientific knowledge. However, the results of choice tests can be very subjective and only ask what that individual wants at that one moment in time; choices can and do vary between individuals and even by the same individual over different time periods and under different circumstances.

Introduction

Improving animal welfare is one of the most important aspects of animal management and husbandry. There are many different definitions of animal welfare which have developed over time. In 'The Brambell Report' (1965), a notable publication which led to the formation of the Farm Animal Welfare Council and the development of the Five Freedoms, welfare is defined as "... both the physical and the mental well-being of the animal." Duncan (1993) included feelings into the definition of welfare: "Welfare is to do with what animals' feel.", while Broom (1986) concentrated on measurable characteristics of assessing welfare, defining it as: "...its state as regards its attempts to cope with its environment". More recently, Dawkins (2008) provides a simple and succinct definition of a good welfare state: "Animals that are healthy and have what they want."

It is impossible to ask an animal directly how it feels and what its state of welfare is; one method in which to gain insight into this is to observe their behaviour. There are many different methods of measuring animal behaviour, from observing enclosure usage and looking for any patterns, to simply watching and recording behaviour for a set period of time. Prior knowledge of what is normal for that species and individual given its age, sex and history is required to make good quality judgements on explaining the behaviour observed. To ask an animal what it wants requires different methodology, and one way in which to attempt to answer this question is with choice and preference tests.

Choice and preference tests (hereafter 'choice test' refers to both choice and preference tests) have been widely used across numerous species for a variety of different reasons. Choice tests are used to ask an animal what it wants and in some cases if a cost is involved, it is possible to assign some sort of value on what an animal chooses in comparison to other options. The choices an animal makes or the preferences it shows are influenced by motivation. Motivation is mediated by internal and external cues resulting in the causation of behaviour (Hogan 2005), but, though it cannot be proven, it is generally accepted that feelings can also drive motivation and the two work together to produce a behaviour (Kirkden and Pajor 2006). For example, a person can feel hungry, there would be input from hormonal regulation and stretch receptors in the stomach and so they would be motivated to eat. It is, however, difficult to positively state that an animal definitely has feelings, though there are plenty of studies both for (in invertebrates: Sherwin 2001, in fish: Chandroo et al. 2004, reviews: Kirkwood 2001; Duncan 2006) and some against (pre-birth in farm animals: Mellor and Diesch 2006, in fish: Rose 2007) the case and it is beyond the scope of this review to argue them here. The strength of the motivation for a particular resource can lead to an animal preferring or choosing one resource over another (Kirkden and Pajor 2006). This can be a preference between resources which could satisfy the same need and therefore be classed as substitutes for each other, or in the case of resources which would satisfy different needs, a difference between strengths of different types of motivation resulting in choosing or preferring one resource over another (Kirkden and Pajor 2006).

The results and conclusions drawn upon of a choice test can have implications for the individual, a group of animals and the species as a whole depending on the methodology used and the types of questions asked. Choice tests have been previously used in studies investigating environmental enrichment preference (see Jones et al. 2000; Jensen et al. 2008), to food and its presentation (see Goodwin et

al. 2002; McGowan et al. 2010; Rioja-Lang et al. 2012), enclosure and enclosure furniture preference (see Jeppesen and Heller 2000) and mate choice (see Forstmeier and Birkhead 2004), some of which can have welfare implications on the subsequent management of a captive animal. However, they do have their limitations and it is easy to come to the wrong conclusion by misunderstanding the reasons behind an animal's actions.

This review will investigate choice tests with regards to their application and relevance in a practical setting. The following points will be considered: the methodology of choice tests (cost versus non-cost, the number of options), choice tests examining environmental enrichment, food and food choices, and finally the limitations of choice tests.

Methodology of choice tests: cost versus non-cost

Choice tests can entail a cost; the more important the resource or option is to an individual, or the more motivated it is to have that resource, the more likely it is that the animal will pay a higher cost to have access to it (Bubier 1996). Cost can be imposed in two ways. The 'price' of a resource or option can be increased, making the animal work harder for it, for example Tilly et al. (2010) incurred cost to laboratory mice by increasing the weight of doors to gain access to enriched cages, and Jensen and Pedersen (2007) trained pigs, *Sus scrofa domesticus*, to press panels an increasing number of times over a period of six weeks to gain access to a reward of rooting material. The second method in which cost can be assigned is by manipulating the time left available to the individual for other activities aside from the resource or option it has chosen, for example Hill et al. (1986) shortened and lengthened day length so that any time spent feeding would be costlier during a shortened day than a lengthened one with regards to remaining time for other activities (Bubier 1996).

Imposing cost to resources or choices can result in different outcomes of the animals' preferences when compared to the results of non-cost conditions. For instance, Bubier (1996) found that hens, *Gallus gallus domesticus*, altered the order of their preferences for different resources (during no-cost grass was most favoured, in cost it was food), and entered areas containing the resources less when a cost of squeezing through dowels to gain access to these resources was imposed. In the same study the author undertook another experiment to find if there were any differences in the time-budget of hens which were either allowed 22.5 hours free access to all resources and then tested, or were housed in a barren cage for 22.5 hours prior to testing (cost condition) (Bubier 1996). Hens in the cost condition displayed more agonistic behaviour and preened less than those in the no-cost condition, implying that those in the cost condition found it stressful (Bubier 1996). The imposition of cost can, therefore, be seen to provide a truer representation of an animal's preference; however it is important to bear in mind the price of the cost in terms of animal welfare.

Methodology of choice tests: number of resources

The number of options or resources an animal is presented with can have an important impact on the results of the test. In simple two-choice tests, typically undertaken using a T- or Y-shaped maze, the question being asked is which one is the most preferred. If a resource can be identified as important to an animal, it is

then possible to then measure the importance of other resources relative to that by presenting them together (for example see: Jensen and Pedersen 2007)

By presenting more than two options it is possible to measure levels of preference for several resources together, though there is the possibility of the animal making non-independent choices; the choice of one particular resource may then influence the level of preference for other resources (Bateson 2004). For instance, Mason et al. (2001) presented captive mink, *Mustela vison*, with seven different resources including a pool of water and a raised platform, of which the pool was found to be the most important resource. Additionally, it was found that the platform was also highly rated, and the mink tended to use the platform to dry off after using the pool; possibly the initial choice of the pool then influenced the choice of the platform (Mason et al. 2001). In this case, it could be considered that the choice of the platform complemented the choice of the pool (Bateson 2004). Another way in which the presence of one resource influences the likelihood of another resource being chosen is if the two resources could substitute each other. Jensen et al. (2008) conducted a study on rooting material preference in pigs, where the pigs were presented, one category at a time, with three slightly different types of rooting material which were classed under six different categories. In only one of the categories, 'earth' (compost, peat and wood-shavings), was there a significant preference made, the rest showed no significant preference (Jensen et al. 2008), perhaps as a result of the three resources within each category being too similar and being substitutions for each other.

While care must be taken to try reduce the impact of non-independent choices being made it is not something which is entirely avoidable, and so it is something which should be factored in when analysing results. If complementary resources can be identified (for example, the captive mink) it may be that to improve husbandry methods both resources should be offered to have a positive impact on welfare.

Environmental enrichment

Environmental enrichment can be defined as a principle which aims to increase the quality of the care of a captive animal by providing environmental stimuli necessary for optimal welfare (Shepherdson 1998). Numerous studies have found that environmental enrichment can reduce, though not eliminate, stereotypic behaviour (Hogan et al. 2010; Tilly et al. 2010); it has been suggested that the reasons behind this persistence may be that the enrichment offered is not quite optimal, or that the stereotypy itself has become so deeply rooted that it is resistant to change (Mason et al. 2007). In some species such as house mice, *Mus musculus*, environmental enrichment has also been shown to increase the amount of time an individual spends performing 'normal', species specific behaviour (Tilly et al. 2010).

Conversely, in some studies, authors have reported that the addition of environmental enrichment can result in higher levels of aggression (Haemisch and Gartner 1994; Barnard et al. 1996), higher levels of corticosteroid (Hutchinson et al. 2012), and increased occurrence of stereotypic behaviour (Carlstead 1991). Barnard et al. (1996) found in their study on male laboratory mice, mice in enriched cages were more aggressive than those in non-enriched cages, which the authors suggested to be a result of the enriched cages providing features which dominant mice defended. Hutchinson et al. (2012) reported that female mice brought up in enriched cages had higher levels of urinary corticosteroid compared to those brought

up in non-enriched cages, though the authors did raise the issue of the suitability of the enrichment (cotton pads for nesting material). Suitability of enrichment for the species concerned is important; Carlstead (1991) provided fennec foxes, *Vulpes zerda*, with sand as an enrichment which actually resulted in an increase in stereotypic behaviour. The correct and suitable provision of environmental enrichment, therefore, is an important factor of animal welfare.

Several studies have investigated an animal's environmental enrichment preference through the means of a choice test (for examples see: Jones et al. 2000; Jensen and Pedersen 2007; Jensen et al. 2008). Asking an individual which option it prefers out of a range of enrichment types could then lead to the improvement of future enrichment, and, if done on a large enough scale, gives insight into what may be suitable for a captive species in general. Jensen and Pedersen (2007) found that, when given the choice and under cost conditions, pigs preferred maize silage mixed with straw, spruce chips and compost more than chopped straw. This is of particular interest as straw is often used as enrichment for pigs as rooting material, and yet, in this experiment at least, pigs preferred more complex rooting materials, which could have implications for the provision of rooting enrichment (Jensen and Pedersen 2007). Similarly, Jeppesen et al. (2000) found in their study investigating different types of nest box in farmed silver foxes, *Vulpes vulpes*, and blue foxes, *Alpoex lagopus*, a clear preference in both species for elevated nest boxes. These farmed foxes are traditionally supplied with a wooden breeding box placed on the floor, so the results of this particular study could, again, have implications for the management of these captive animals (Jeppesen et al 2000).

It is clear that asking questions about an animal's preference for different forms of enrichment is important to improve both scientific knowledge about that species in captivity, and to improve animal welfare and management standards. However, it is important to bear in mind that what a human may deem to be suitable as an environmental enrichment, the animal may not, indeed, we may never design the perfect enrichment. Enrichment design can only be improved by observing the animal as it interacts with the item, as well as taking that particular species' natural environment, habits and biology into consideration when designing enrichment.

Food and feeding choices

In a captive setting asking questions about an animal's choice of food and feeding method can be important in meeting their nutritional requirements and for their well-being. For the majority of wild animals locating food is one of the largest parts of an animal's activity budget. For instance, wild giraffes, *Giraffa camelopardalis*, spend up to 60% of their day browsing (Bashaw et al. 2001). In captivity, the food is normally presented to the animal by the humans who care for it, and choices on the type of food are made for it. By investigating preference it is possible to gain more information on the feedstuffs an animal prefers, the results of which can influence the way in which food is presented and the type of food fed to the animal, in some cases improving welfare.

Goodwin et al. (2002) provide a good example of using a choice test to implicate feeding methods. The authors provided horses, *Equus caballus*, with a stable containing a previously determined preferred forage and compared their behaviour to that observed in a stable with multiple forages, and found that horses would forage more, even eating less preferred forages in the stable containing multiple forages,

compared to the one containing just the preferred forage. Additionally, stereotypic individuals only displayed that behaviour in the stable with the single, preferred forage (Goodwin et al. 2002). Stabled horses are typically offered just one type of forage, but when grazing they will eat a wide variety of species (Goodwin et al. 2002). The authors suggested that the provision of multiple forages for horses whilst stabled could increase natural feeding patterns and decrease the amount non-foraging behaviour, including stereotypic behaviour, which could indicate the individual's motivation to search for alternative foodstuffs (Goodwin et al. 2002).

The way in which food is presented can impact the behaviour of captive animals. Proximity to other animals can impact an individual's feeding behaviour, especially in the case of social species such as domestic cattle, *Bos primigenius*. Rioja-Lang et al. (2012) presented subordinate cows with a Y-maze test and the choice of low-palatability food alone, or high-palatability food next to dominant cow at different distances. At the closer distances of 0.3 metres and 0.45 metres the subordinate cows preferred to feed alone, though even at the larger sizes of 0.6 metres and 0.75 metres, some subordinate cows still preferred to feed alone (Rioja-Lang et al. 2012). The authors of this study suggested that based upon their results, feeding spaces for cows should be at least 0.6 metres per cow which could potentially impact on the way in which cows are managed and, in turn, their welfare.

One point to consider when using the results on a choice test regarding food choices is that the animals may show a preference to something which is not appropriate to be fed on a regular basis. For instance, an individual may choose a food-stuff which could make them over-weight (Broom 1988; Goodwin et al. 2002), which could be of particular importance considering captive animals can be more prone to being overweight with its associated health problems. Another example of choosing a food which is inappropriate comes from a purely production angle. Van den Brand et al. (2007) found that when pigs were offered a variety of different types of food they were able to choose the one that provided suitable protein, but they were unable to choose the one which met their requirements for optimal growth. However, in this case there may have been issues with the palatability of the different feeds offered (van den Brand et al. 2007), highlighting the need to ensure the food offered is suitable, and it is also doubtful whether optimal growth for production is most important to the pig itself.

Limitations of choice tests

While choice tests are undoubtedly very useful in asking questions about what an animal wants and can have implications on animal welfare and husbandry methods, they do have their limitations. A choice or preference an animal shows can be very subjective, and it can be restricted to that particular individual's preference at that moment in time which could potentially change at some point in the future, both long- and short-term. For example, Arey (1992) found when pregnant pigs in the latter stages of pregnancy were given the choice of food and straw, they spent more time in the area where food was available until two days before farrowing, when straw became as important as food. Under the influence of four different hormones, progesterone, prolactin, oxytocin and somatostatin, pigs are highly motivated to nest-build from two days pre-farrowing up until birth (Castrén et al. 1993) explaining the reason why a difference in the importance of straw was observed. Likewise, Færevik et al. (2005) found in their study testing the preferences of sheep for different flooring types, that unshorn sheep showed no clear preference for any of the flooring options,

but once they were shorn they showed a clear preference for straw and wooden floor, with their low thermal conductivity, over harder floor such as expanded metal. For the results of a choice test to positively impact husbandry methods and welfare they either need to be repeatable over a wide range of individuals and time frames, or the scientific reasoning behind inconsistencies and changes in preferences needs to be fully understood.

Conclusion

Choice tests are a valuable tool in asking animals what they want, and can be used to positively impact on welfare, improve husbandry methods and expand scientific knowledge. The methodology of a choice test can have an influence on the results seen, for instance cost versus non-cost, and the effect of the number of resources offered and whether they themselves can impact on the likelihood of other resources being chosen. Choice tests have been widely used for asking questions about enrichment and food preferences. While the results are useful, it is essential to remember that an animal's preference can vary, and it is important to understand the reasons behind inconsistencies in preference, be it due to hormonal influences (as seen in the pre-farrowing pigs), or because different resources are important at different times, simply because the animal has no real preference, or if the resources offered are not suitable.

There are aspects of choice test which could be worthy of further research. Choice tests have not been used, to my knowledge, to investigate the preferences of wild animals. This is an area which would have many practical issues which would need to be overcome, but could be important in ensuring good quality care and welfare to captive counterparts as well as improving scientific knowledge about that species. Additionally, most experiments only last a relatively short period of time (typically days to weeks), and so changes in an individual's preferences as it ages (focussing on individual differences rather than comparing two individuals of different ages) is another area which could be researched to extend knowledge.

In my study 13 donkeys, *Equus asinus*, were presented with a choice test consisting of five different items: concentrate feed in a bucket, a pile of hazel leaves and branches, *Corylus avellana*, a handler, a car tyre and another donkey. All items were set out equally on a semi circle around the point from which the focal donkey was released and were equidistant from the release point. Each donkey went through 10 trials (with the items in a different order for each trial), all of which lasted five minutes. The study aimed to identify any preferences with future environmental enrichment in mind, as well as possible use of items as reward/motivational items for future cognitive studies.

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