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研究課題名（和文）児童の発達における伴侶動物の影響：人と動物の「絆」を生むものは何か

研究課題名（英文）What is the bond between human and companion animals? From the child development point of view

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研究成果の概要（和文）：本研究は、異種間コミュニケーションを検討することで、児童と伴侶動物の間の絆を明らかにすることを目的とする。具体的には、乳幼児はイヌに、例えば、食べ物やおもちゃを独り占めするのではなく、イヌと分け合うといったような、向社会的選択行動を示すのか、といったことを調べてきました。
この結果、ミラーテストは成功しなかった乳幼児でも向社会的選択行動を示すこと、つまりイヌと食べ物を分け合うといった行動を示すことがわかりました。一方、乳幼児との間にポジティブなオキシトシンループを持つイヌ（このことはイヌが乳幼児の顔を長く注視する、といったことから示されます）は向社会的選択行動を示すことがわかりました。

研究成果の学術的意義や社会的意義
ともに暮らす動物の存在が子供の知覚、認知、言語の発達を促すことは数多くの先行研究から示唆されている。しかしながら、子どもと動物の間のどのようなインタラクションがしているのかはほとんどわかっていない。この研究は異種間において向社会的行動が生じることを示した初めてのもので、伴侶動物としての長い歴史の過程でイヌがこの能力を獲得してきたことを示唆します。これまで社会的相互作用の進化については主に類人猿とヒトを比較することで検討されてきましたが、本研究はこの問題の解明にイヌ科動物の社会行動の比較調査が役立つことを示したものであり、進化学に新たなツールを提供するものと考えます。

研究成果の概要（英文）：We tested the social communication abilities between child and dogs, such as reading social cues (eye sight or hand sign) and the prosocial behavior between different animals (the ability to share resources with others). We found that even infants which do not pass the mirror test (do not yet show self recognition) can still perform the prosocial behavior (share food or toys with the dog instead of occupy the food or toy by themselves) toward the dogs. On the other hand, only dogs which show positive oxytocin loop (star longer time to the child's face) perform the prosocial behavior. This is the first study testing the prosocial behavior between different animal species, and can give us insights to the evolution background of prosocial behavior, which is very important in all the social animal societies.

研究分野：社会行動

キーワード：prosocial behavior　domestic animals　social evolution

様　式　Ｃ－１９、Ｆ－１９－１、Ｚ－１９、ＣＫ－１９（共通）

１．研究開始当初の背景

Research on the bond between humans and companion animals has started recently but increased dramatically over the last 30 years. Evidence shows that instead of the pets' loving companionship, they also provide many types of health benefits. Interaction with companion animals has been reported to have a positive impact on physical and mental well-being and to promote physical condition recovery. Physiological measurements show evidence that blood pressure, triglycerides and cholesterol levels have been restored by interaction with animals. However, most of these data are for adults, and little research has been done on the bonds between children and animals.

It is common for family with kids to keep pets. In the US, more than 70% cases of family which own pets also have kids in the family, and the reason for acquiring the pets is "for the children", for example the pets may teach children lessons about responsibility while providing companion. Children grow up with pets are known to have higher scores of self-esteem, independence and empathy, as well as coordination and altruism (Endenburg, 2011). But basic study related to which type of social interactions occur between children and companion animals remains largely unknown. It is necessary to understand the formation of the social interactions between children and dogs, since hererospecific communication is extremely rare in nature.

The possible relationships between children and pets including empathy, coping with stress, emotion regulation, self-control, social support and physical activities. Children are innately attended to living things (especially animals) possibly due to evolutionary reasons. On the other hand, it is believed that animals which are closer to human should be easier to interaction with, but dogs seem to have better ability reading human social cues compared to our closest relatives, the chimpanzees, and to their closest relatives, the wolves. Chimpanzees are better at understanding the cause and consequences of one task compare to dogs, but dogs outperform chimpanzees in reading human social cues. It is believed that such ability evolves through long period of domestication, so studying the evolution of social ability in dogs might give us hints of how social ability evolves in other animals, including humans.

Here we aim to test whether children and animals are able to read social cues from each other, and the level of empathy between them.

２．研究の目的

Here, we aim to study the types of social interactions between children and dogs, for example how they read social cues between each other, and whether they show empathy toward other species. We also asked where the special heterospecific social ability might come from, by testing the relationship between social experience and the ability to read social cues from other species. It is shown that living with companion animals enhances infants' perception, cognition and verbal development, but which type of interaction they share and which behavior is important for development remain underestimated and need more scientific support. We try to ask (1) the ability to read social cues in both children and dogs, (2) the relationship between social experience and the ability of reading social cues, and (3) the level of empathy shared by children and dogs.

３．研究の方法

First, we tested the ability to read social cues (eye gaze and hand sign) in both children and dogs. We collected stray dogs which we assume to have limited interaction with human, and the stray dogs adopted by families for one month, in order to test how experience living with human change their ability of reading human social cues.

We tested (1) the ability of children to read dog social cues and (2) the ability of dog to read child social cues. Tasks include indicating a hidden food or toy in boxes using eye gaze or hand pointing position. We also tested the ability of reading social cues in (1) dogs with no social experience with human (stray dogs), dogs with one month social experience living with children, and dogs live with children for more than two years, and (2) children with no experience living with dogs, children live with dogs for one month, and children live with dogs for more than six months.

Second, we test the synchronization behavior between the children and dogs. Behavioral mimicking is known as a type of behavioral contagion, and is believed to be the basis of empathy. We setup markers on both children and dogs. The markers are coated with a retroreflective material to reflect light that is generated near the camera lens, and the 3D position of the marker is estimated by eight motion capture cameras. We use the system to capture the behavior during free interaction between children and dogs. We

use the beta process hidden Markov model (BP-HMM) to automatically and objectively separate the behaviors of both children and dogs. We also use other physiological measures such as the heart rate of both children and dogs and its variability. We attached a sensor for electrocardiogram (ECG) measurement (eMotion FAROS 90°, Bittium Biosignals, Ltd.) followed with the methods used in Katayama et al 2016. A small amount of electrode gel (GEL 100, BIOPAC Systems, Inc.) was applied to the skin of the dogs to increase conductivity, and cottons wetted with saline were sandwiched between the electrode and dog skin. The sensor and the band cable were wrapped around with self-adhesive dressing (3 M Vetrap Banding Tapes, 3 M). Dogs were able to move freely with the device.
Last, we test the prosocial behavior in both children and dogs. We first train the child or the dog between two types of tokens, one is reward with food or toy and the other is not. Only the participants who are able to pass the task are allowed to perform the experiment. We then use another two types of tokens; one is only self-rewarded (selfish token) and the other rewards both the dog and the child (prosocial token). We let the children and dogs to choose between the two tokens and record the type of the token they choose.

4．研究成果

First, we found that the ability of reading social cues from other species is correlated with the experience with the species. Children with no experience with dogs show significantly lower accuracy for reading the cues expressed by dogs indicating where the food is. Stray dogs which have limited human experience also failed to follow the pointing and eye gaze expressed by human indicating where the food is. Children and dogs who have experience with the dogs/children shoe significant increase of ability reading heterospecific social cues, but there is no significant difference between children/dogs with one-month experience or more than 6-month experience.
Second, we find behavioral synchronization is significantly correlated with the amount of heterospecific experience. There is no significant difference between the occasions which children or dogs initial the synchronized behavior, which is different from the adult studies. In dyads between adult human and dogs, it is more often that the human initial a synchronized behavior. The relationship between adult and dogs might be different from children with dogs, and more data is needed to clarify the relationship between children and dogs, in order to understand their interaction better.
Last, we find that children are able to show prosocial behavior toward dogs. They are able to choose more prosocial tokens than selfish tokens, and interestingly, even children who do not pass mirror test are able to perform prosocial behavior. Mirror test is believed to reflect self-recognition, thus performing prosocial behavior might not require self-consciousness. On the other hand, not all the dogs can perform prosocial behavior toward children. Only dogs which show positive oxytocin loop with children, e.g. the individuals which look at the face of the children longer, are able to choose significantly more prosocial tokens compare to the selfish tokens. It is also possible that the prosocial choice is simply the result of the attention focusing of the dogs. Since the prosocial dogs look longer at the face of the children, it is also more likely that they are aware of the need of the children. Our results show the prosocial behavior between children and the dogs, which is the first study showing the prosocial behavior between animals from different groups. The social ability of dogs is extremely higher than many other animals which are closer to human evolutionally. This special ability may be evolved through long period of domestication selection. Thus, studying the development of dog social behavior may give us a hind of how social behavior develop in our species as well.
We also found that dogs are able to show the possibility of contagion of child emotions, using physiological indicators. We found that the HRV indicators of dogs varies depending on their arousal state. We also found that negative emotion of the child was contagious to dogs, and there is possibility that positive emotion was contagious to dogs as well. This study made it possible to perform emotional measurement taking into consideration the arousal states of dogs by HRV measurement for a short time. Also, not only behavior but also HRV indicators suggested that dogs may empathize with human emotions.
As research continues to indicate the potential for children health benefits from interacting with pets, it is becoming increasingly important to be able to identify the underlying mechanisms that are responsible for these gains in health and well-being, and the nature of these behaviors. A future direction is to focus on the

neurobiology of child-pet bonds, for example the neuropeptides such as oxytocin and vasopressin which are important in forming human social bonds. This will not only help us understanding the biological background of human-animal bonds, but also the evolutionary and neurobiological bases of human social interactions as well.

５．主な発表論文等

〔雑誌論文〕（計　2　件）

(1) Kabuto, K., Wang, M.-Y. & Ueda, K. (under preparation) Emotional contagion in dogs toward their owners: evidence from HRV data. PloS one.
(2) Wang, M.-Y. & Ueda, K. (under preparation) The prosocial behavior between children and dogs. Scientific Reports.

〔学会発表〕（計　1　件）

(3) Wang, M.-Y. & Ueda, K. (2018) The prosocial behavior between children and dogs. Proceedings of the 55th Annual Conference of Animal Behavior Society.

〔図書〕（計　0　件）

〔産業財産権〕
○出願状況（計　0　件）

○取得状況（計　0　件）

６．研究組織

(1)研究分担者

なし

(2)研究協力者

なし