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# What is the Potential of Animal Models to Inform Occupational Therapy Theories and Interventions From the Perspective of Neuroscience?

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## Abstract

**Introduction :** Animal studies cannot be applied directly to Occupational Therapy(OT) intervention protocol. However, animal models still provide essential evidences and knowledge to improve OT practice and to develop OT theories as well as human studies do. The purpose of this scholarly paper is to explore the potential of animal models to inform OT theory and practice particularly as it relates to neuroscience.

**Body :** The animal models provide related knowledge for a better understanding of the mechanism of diseases and related neural networks. Based on this knowledge, researchers can test their hypothesis of neural disease. In addition, accumulated animal studies contribute to introduce the new approaches to human diseases and to improve the effectiveness of treatment.

**Conclusions :** Animal models of neurological disease are critical and have the potential to improve OT practice and theory in many ways. Therefore, OT researchers need to pay more attention to animal models in addition human studies.

**Key words :** Animal model, Neuroscience, Neurological disease

## Ⅰ. Introduction

Many studies, including human and animal models, contribute to develop occupational therapy theories and practice. Therapists and researchers in occupational therapy(OT) are more interested in human studies than animal models because human outcome studies directly evaluate the effectiveness of OT in humans, and give direct feedback to practitioners about their treatment.

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Therefore, they can apply the protocol from human research directly into their practice. In contrast, practitioners cannot directly apply results from animal studies into daily OT intervention protocols. However, animal models still provide essential evidences and knowledge to improve OT practice and to develop OT theories as well as human study does.

OT is a profession concerned primarily with promoting health and well being through occupation. Occupation is defined as "everything people do to occupy themselves, including looking after themselves…enjoying life…and contributing to the social and economic fabric of their communities…"(Law, Polatajko, Baptiste, & Townsend, 1997). In OT, occupation is not only the final goal (occupation-as-end) but also the way (occupation-as-means) to improve well being(Kielhofner, 1997; Roley et al., 2008). For example, occupational therapists can use cooking activities as a therapeutic mean, and also cooking is one of the very important goals for Activities of Daily Living(ADL). OT supports the participation in life by assisting engagement in occupation. The process of OT practice consists of three parts: evaluation, intervention, and outcomes. Throught this whole process, occupational therapists are concerned with six domains: performance in areas of occupation, performance skills, performance patterns, context, activity domains, and client factors(Roley et al., 2008). These domains cover various contexts as well as human factors because an essential property of participation in life is the compound interaction between an individual and contexts(Roley et al., 2008). Based on these domains, OT practice is biopsychosocial and carried out through specific Conceptual Practice Models(CPM)(Kielhofner, 1997).

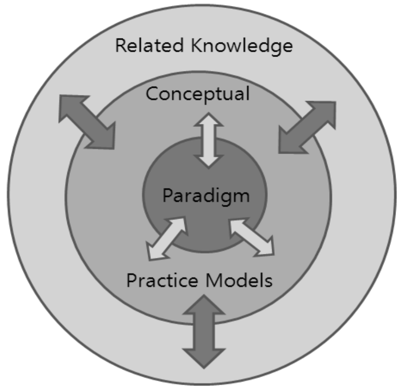


Figure 1. Dynamics of the knowledge base modified (Kielhofner, 1997)

CPMs, unique to OT theory, provide rationale and guideline for OT practice. The three concentric layers of knowledge for the foundation of OT theory consist of paradigm, CPMs, and related knowledge(Figure 1). The paradigm, a common vision of members in OT, is the inmost core because it addresses the view and the identity of OT in the therapeutic environment. Related knowledge, including concepts, facts, and techniques from other disciplines, complements unique knowledge and applies to OT practice. These three components are dependent of each other and they have mutual influences. CPMs give influence to the paradigm and take influence from both related knowledge and paradigm, called dynamics of the conceptual foundation(Figure 1). The dynamics of this system structure, CPMs more rapidly change than paradigm, which is relatively stable, because feedback from research, outcome of practice, and CPM application in practice results in steady adjustment of CPMs.

Animal research generates the new related knowledge to alternate CPMs as well as human research does. During this process, related knowledge from research provides feedback to enrich the related knowledge itself and to make CPMs more rational and effective in practice(Kielhofner, 1997). In neuroscience aspects, animal models of neurological disorder has advantages to demonstrate biological evidence related to functional improvement due to therapy because investigators can use relatively more invasive techniques without ethical issue and biases can be better controlled than in a human study. It can test same treatment repeatedly in the same condition. For example, animal studies provide different kind of the related knowledge to support Constraint-Induced Movement Therapy (CIMT) protocol such as neurological changes after stroke, biological effects of CIMT, and functional improvement. Even though the therapists cannot use the CIMT protocol of monkey research in treatment, interestingly the CIMT concept comes from non-human primate study. Without studies in non-human primate model, CIMT cannot be developed for use in humans.

Occupational therapists and researchers should give more attention to animal studies. Obviously occupational therapists treat people who have difficulties with participating in occupation and the knowledge from human studies can be applied directly in their therapy. In OT for neurological disorder, therapists believe that OT treatment improve occupational performance due to neurobiological changes. Animal study has provided neurobiological evidence to explain mechanism of treatment for neurological disorder. Besides the human studies, animal studies provide different kinds of evidence to influence theory and practice in OT. There are many way for animal model to contribute to OT.

However, a majority of occupational therapists and researchers less concern animal studies. The purpose of this article is to explain why animal studies are important for OT theory and practice especially as it related to neuroscience.

# Ⅱ. Body

## 1. What are advantages of animal studies?

Before addressing how research with animal model influences occupational therapy, this section is reveals the general benefits of animal studies to generate essential evidence or related knowledge influencing OT theory and practice. In OT paradigm, humans fulfill their own particular needs or motivation through occupation defined as everything people occupy themselves. Humans have the needs and motivations to participation in tasks and activities meaningful for themselves, which is referred to as occupational nature or needs(Kielhofner, 1997).

These occupational needs and motivations have biological and psychological foundation.

Biologically-based needs may, for instance, be thought of as responses to stages of development in the nervous system, to maintain cardiorespiratory fitness, and to generate motor skills (Bruner, 1973; Parent, 1978). Psychologically-based needs include the requirement that an individual recognizes a degree of ability and engagement in occupations(Fondiller, Rosage, & Neuhas, 1990). The individual is satisfied with both needs by participating in their own occupation with their own functions. Participation in occupation has effects on biological and psychological status(Kielhofner, 1997); while the biological and psychological capacity, such as motor and cognitive function, also affects participation in occupation(Kielhofner, 1997; Law et al., 1997; Roley et al., 2008). Thus, the capacity and occupational performance are inter-dependent and related to the functioning of the nervous system since these functions stem from core neurological processes(Lohman & Royeen, 2002). This mutual relationship is the theoretical foundation of OT in neurological disease. Animal studies have two advantages to show neurological changes in investigating this reciprocal relationship between occupational participation and recovery in the neural system.

First, investigators can provide same environmental and biological conditions in which to study animals, something that is impossible in humans. Many factors, such as diet(Ahmad, Park, Radel, & Levant, 2008), environmental condition (Llorens-Martin et al., 2007), genetics, age(Ahmad & Spear, 1993), and disease, could be outside factors that affect neural changes in neurological studies. In human studies, it is not easy to control these factors because each subject has different characteristics in life style and controlling every factor in humans could potentially be an ethical issue. The variation of these factors can be contaminants on an experiment in humans.

However, in animal studies, the investigator can more easily control these factors by providing same artificial environment to the target group which has same biological condition. For example, investigators can provide the same cloned condition by using transgenic animals, and providing the same artificial environment by controlling temperature, light, and space. Therefore, well controlled variables, in animal studies, improve the causation of neurological changes because contamination is reduced by controlling variables in the experiment. In addition to controlling external factors, animal models have another methodological advantage to demonstrate precise neurological data.

Investigators can use various direct treatments to reveal neurological changes in animal models. There are several methods to investigate biological changes such as electrophysiological, physicochemical, imaging and stereological techniques.

Except for some imaging techniques including Magnetic Resonance Imaging(MRI) and Computed Tomography(CT), most of these are invasive. It is impossible to use such methods in humans because of practical and ethical issues(Cramer & Riley, 2008). Hence, investigators have more methodological options to identify neurological changes in animal models than in humans. There are several invasive techniques to measure neurobiological changes. For instance, by using electrophysiological technique: the micro-stimulation within the vicinity of the corticospinal neurons under certain anesthetics induce muscle contractions(Nudo, 2006b). It is possible to define functional areas in the motor cortex. Classically, the functional representation of a given motor cortical area is defined by the muscles contraction initiated by the lowest stimulates in current level(Stoney, Thompson, & Asanuma, 1968). This invasive electro-physiological technique is used to investigate the change of functional representation in cortex after the intervention. Also, the activity change due to treatment in specific deep brain nucleus, such as the caudate-putamen, can be detected by electrophysiological recording procedure (Glynn & Ahmad, 2003). In addition, stereological methods are very useful to find anatomical changes such as the cell number and the cell body volume of neurons(Schumann & Amaral, 2005). By using a computerized stereological system, investigators can count the neurons and measure the cell volume under the microscope. Investigators are limited to use invasive method to prove these types of biological changes in humans. They cannot use invasive techniques, such as stereological methods, in humans because they cannot take the brain until the subject dies. Even though researchers may collect anatomical data after the death, the causation of anatomical changes is less clear because the duration between intervention and data collection is quite long. Animal models can make up for these limitations found in human studies. Thus, animal studies provide a more precise picture of neurological changes directly by invasive techniques.

The nervous system and participation in occupation are interdependent in the OT aspect because neural processes, which are biological psychological function, are essential to participate in occupation and also participation in occupation improves neural process. Thus, it is important to demonstrate the alternation in the nervous system to support this mutual relationship. Animal studies have mainly two advantages over human studies in the investigation of the neurological changes. First, well controlled factors in the experiment reduce contamination in causation of neurological changes.

Second, many methodological options, including invasive techniques, increase precision of neurological data. These two advantages are core reasons to make research with animal models more suitable to investigate effects of occupational participation on the neural system. Based on these benefits, many animal studies have demonstrated the positive effect of occupation on the nervous system.

The animal studies is one of scientific methods to demonstrate the therapeutic use of occupation in the nervous system. In specific CPMs, such as the cognitive-perceptual model, the motor control model, and the sensory integration model, disorder means deficits of neural processing. Therapists use occupation as a means of treatment to improve neural processing, especially in people with neurological disease. There are five main pathways to employ occupation as therapy: providing opportunities to engage in occupation, modifying environments, providing techincal devices, and counsel/problem solve(Kielhofner, 1997). Occupational therapists believe that they improve the neurological condition through these pathways especially by providing opportunities to engage in occupation and modifying environment. This belief, one of core concept in OT practice and theory, is supported by neuroplasticity and neuro-occupation. Neuropalsticity is the capability of neural system to reorganize itself as a result of experience(Nudo, 2006b; Shaw, Lanius, & van den Doel, 1994). Neuro-occupation, one of OT theoretical construct, is the conceptualization that human occupation and the neural system are interdependent, interactive, and affected by environment(Lohman & Royeen, 2002). Many animal studies based on these two major conceptual constructs demonstrate this mutual relationship by revealing that characteristics of engagement in occupation, such as required action (motor or physical requirement) and required performance skills, and environmental changes induce to alternate the neurological status.

Studies with animal models suggest physical activity improves the function of the neural system. Occupation means doing something meaningful to the individual in OT(Kielhofner, 1997; Law et al., 1997). Required action is one of the most important domains in OT, which means engagement in occupation has feature of physical action. Therefore, physical activity is one occupation used in OT practice for neurological disease. In our previous study, endurance exercise increased the number of neurons in specific brain areas(Ahmad, Stenho-Bittel, Lau, & Park, 2007). The 1-methyl-4-pheny l-1,2,3,6-tetrahydropyridine(MPTP) chronic Parkinson mice were exercised for 40min per a day and 5 days per a week. The speed of motorized rodent treadmill was up to 15 m/min. We provided same diet and same environment to all 4 groups, such as control group, sedentary Parkinson group, 10 weeks exercised Parkinson group, and 18 weeks exercised Parkinson group. We used stereological method with the computerized system to count the number of dopaminergic(DA) neurons in the substantia nigra pars compacta(SNpc) and the ventral tegmental area(VTA). In both areas, the number of DA neurons was significantly greater in the exercised group then in the sedentary group. Also DA neuron morphology in the exercised group is better than in sedentary group. These results demonstrated that endurance exercise is neuroprotective to DA neurons in the SNpc and the VTA of chronic MPTP mouse model of PD. Research in animal models supports positive effect of physical activities on the nervous system.

Researches in animal models confirm that neuroplasticity is due to skilled demand activity rather than simple repetitive activity. Occupation therapists provide occupation, such as purposeful and skilled activities, to treat people with neurological disorder because engagement improves the nervous system. Various animal studies support experiences of purposeful and skilled activities provide functional improvement. Rats trained in skilled motor task demonstrated more neurons and synapses than the control group in the motor cortex(Kleim, Lussnig, Schwarz, Comery, & Greenough, 1996). Similarly rats, trained in skilled reaching, had more extensive dendritic arborization of motor cortex than non-trained group(Withers & Greenough, 1989).

Electrophysiological mapping showed that reorganization of motor representations in rats trained skilled reaching. The wrist and digit representation increased and elbow/shoulder representation decreased in rats trained skilled reaching in comparison with rats rained un-skilled reaching(Kleim, Barbay, Nudo, 1998). The same kinds of results have been exhibited in primate studies. Motor representative map stayed stable after performing non-skilled reaching activity(Plautz, Milliken, & Nudo, 2000) but motor learning changed M1 representational map in a squirrel monkey after having experiences with motor skills(Nudo, Milliken, Jenkins, & Merzenich, 1996). These animal studies strongly maintain evidence supporting experience-dependent plasticity or learning-dependent plasticity(Kleim et al., 1998; Kleim et al., 1996; Maravall, Koh, Lindquist, & Svoboda, 2004; Rema, Armstrong-James, & Ebner, 2003; Shepherd, Pologruto, & Svoboda, 2003; Withers & Greenough, 1989). In OT, engagement in occupation is physical and mental experience and is required for learning and performing skills(Kielhofner, 1997; Roley et al., 2008).

Therefore, the animal studies on experience- or learning- dependent plasticity firmly support participation in occupation may cause plasticity in neural system, which is implicated as positive effects of occupation on the neural system.

Animal researches demonstrate that environmental changes have positive effects on the nervous system. In animal studies, generally enriched environments(EE) are comprised of bigger housing cages, with objects to interactivity, a running wheel, and tunnels that are changed occasionally to motivate animal exploration(Bezard et al., 2003; Laviola, Hannan, Macri, Solinas, & Jaber, 2008). Several studies on effects of EE on neurological disorders, such as PD(Bezard et al., 2003), Huntington's disease(Nithianantharajah, Barkus, Murphy, & Hannan, 2008; Spires et al., 2004), and Alzheimer's disease(Berardi, Braschi, Capsoni, Cattaneo, & Maffei, 2007; Gortz et al., 2008) revealed that EE enhanced experience-dependent plasticity in transcription of specific genes, synaptogenesis, and adult neurogenesis in the rat model(Laviola et al., 2008). In our pervious study in rats without neurological disorder, EE increased the volume of hippocampus specifically in dentate gyrus(DG), CA1, and CA2. Also morphologically the EE group was better than control group. The positive effects of EE on the neural system support modifying environment in OT as a treatment approach for people with neurological deficits.

In addition to the neurological evidence, research in animal models also provides functional data to support positive effects of occupation on the nervous system. These functional or behavioral data are related to the neurological data. Cortical reorganization reduced failures in reaching task in rats(Kleim et al., 1998). EE improved functions, including maze performance, as well as cellular of pathogenesis in AD rat(Arendash et al., 2004; Jankowsky et al., 2005; Lazarov et al., 2005). In Parkinson rats, endurance exercise improved running ability and motor control as well as the number of neurons in the SNpc and the VTA.(Petzinger et al., 2007) The positive behavioral improvement due to experience-dependent plasticity allows them engage in occupation such as feeding, locomotion, and navigation. The coupling between neurobiological and behavioral improvement due to experience–dependent plasticity in animal models is solid evidence for fundamental OT theory.

In summary, animal models prove positive effects of two major methods to employ occupation as therapy, such as engagement in occupation and environmental changes, on the nervous system. The plasticity due to experience driving occupation or environmental enrichment is the reason of functional improvement. These positive effects on occupation and environment, neurological and functional improvement, are key for OT practice in neurological diseases(Figure 2). Occupational therapists provide the opportunities of engaging in occupation and modify the environment to treat people with neurological disorder. Based on OT theory, the neurological improvement, due to occupational therapy, enhances the functional improvement that allows people participate in occupation. In OT's view, through participation in occupation, the individual can maintain health status and quality of life.

Animal studies have potential to prove this theoretical link of OT practice by providing the evidence for expe rience–dependent plasticity due to engaging in occupation or modifying environment. Animal models also demonstrate the link between the behavioral or functional improvement and neurological improvement. The strong support of animal studies contributes to establishing strong foundation of OT theory and practice in neurological disorders.

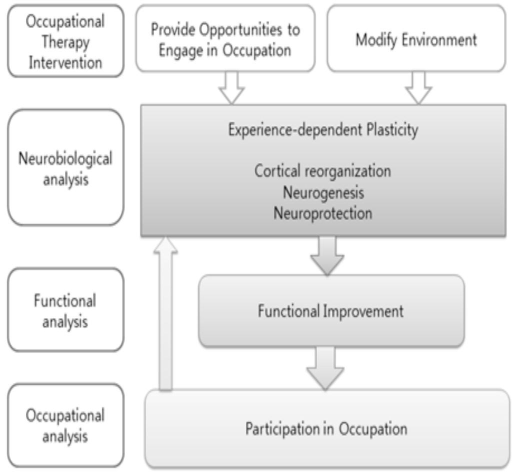


Figure 2.
Dynamics of employing occupation as therapy in neurological system. Occupational therapy intervention induces experience–dependent plasticity such as cortical reorganization, neurogenesis and neuroprotection. This neuro plasticity improves functions in performance skills. The improvement of functions in performance skills help clients participate in occupation. Participation in occupation influences back to the neural system and induces neural plasticity.

## 2. Animal studies provide possibilities and evidence of treatment in humans

The previous section confirms that animal studies demonstrate OT approaches can induce the change of neurological status. This section is about the benefits derived from animal models to be applied for OT in humans. Many kinds of animals, including rats, mice, and monkeys, are used for various purposes in neuroscience. Some of these studies are to investigate the effect of a specific treatment on particular neurological diseases(Nichol et al., 2008; Whishaw, Alaverdashvili, & Kolb, 2008). Through these studies with animal models, researchers provided the possibility for human translational research(Schneider et al., 2007; Taub & Uswatte, 2003). Based on the knowl–

edge from animal studies, researchers design human outcome studies and may expect similar result in humans. For example, endurance exercise preserves the number of DA neurons in the VTA and the SNpc of PD rats. Researchers hypothesized that endurance exercise would preserve the number of DA neurons in people with PD that would attenuate symptom and tested this treatment approach in people with PD(Ridgel, Vitek, & Alberts, 2009). In this case, the previous study in rat PD model provided possibility of endurance exercise as therapeutic intervention in human PD. Without the initial rat PD model, this kind of translational study in humans is impossible. The animal disease model is essential in human translation study. There are some benefits from animal model for translation research into humans.

Researchers can effectively test their treatments and hypothesis on mechanism of neurological disease in animal models. Animal models of neurological disease have been used to inform the mechanism of human disease( Smeyne & Jackson–Lewis, 2005). Neurological deficits in animal models are induced by an artificial method based on the mechanism of human disease and neural network. Animal studies use large samples to contribute to build a specific disease model. Based on accumulated knowledge from these studies, researchers developed the animal model of a neurological disease similar to human disease. For example, neurotoxin and MPTP are commonly used to induce parkinsonism in rodent and primate because this substance induces neurodegeneration in the DA nigrostriatal system(Jenner, 2003a, 2003b; Smeyne & Jackson–Lewis, 2005). Similar motor disturbances and neural circuit changes between animal PD model and human PD supports that MPTP animal model is the closest to human PD(Burns et al., 1983; Manning–Bog & Langston, 2007). Thus, researchers can test their treatment protocols, including pharmacological and non–pharmacological, in animal MPTP model before applying it to human. They evaluate the effect of their protocol by behavioral and neurological changes in the animals. A number of studies in MPTP animal model contributes to development of neuroprotective therapies in PD and activity of antiparkinsonian drugs in humans can be highly predicted based on response of non–human primate MPTP model(Jenner, 2003a, 2003b; Manning–Bog & Langston, 2007). In addition, the animal model of a neurological disease helps OT researchers and practitioners to understand the mechanism and neural network related to the disease. For instance, various animal studies contributed to build the model of neural network of the basal ganglia linked to PD(Aldridge, Berridge, & Rosen, 2004; Yasoshima et al., 2005). Through studies in animal disease models, OT researchers and practitioner update their knowledge on mechanism and the neural network related to the specific neurological disease. With this knowledge, OT researchers and practitioners understand new treatment approaches including both OT and non–OT treatment. Also animal models for neurological disease build the basic foundation for transitional research in humans.

Studies in animal models provide basic evidence to initiate studies in humans with neurological disease. The purpose of human studies on neurological disease is to investigate the effect of treatment. Before applying treatments in humans, researchers should show enough evidence to explain how the treatment works on the disease and what effects are expected. Accumulated studies in an animal model of the neurological disease provide evidence of neurological changes due to the intervention in the target area. CIMT, one of the most interesting treatment approaches in OT, was derived from early primate studies(Taub & Uswatte, 2003). The core concept of CIMT, learned nonuse, came from early studies with monkeys in whom somatic sensation was eliminated surgically from unilateral upper extremity by dorsal rhizotomy. The monkeys regained use of affected extremity by forced training affected upper extremity or restricting the movement of unaffected upper extremity (Taub, 1980). Based on this primate study, the same mechanism was thought to apply to human with motor deficits of upper extremity due to neurological disorder such as stroke and cerebral palsy(Blanton, Wilsey, & Wolf, 2008; Boake et al., 2007; Hoare, Imms, Carey, & Wasiak, 2007; Hoare, Wasiak, Imms, & Carey, 2007; Kwakkel, Rietberg, & van Wegen, 2007; Taub et al., 2006). Occupational therapists use CIMT with people with motor deficits of the upper extremity to improve the level of physical function and participation in occupation of daily living(Martin, Burtner, Poole, & Phillips, 2008; Page, Levine, & Hill, 2007). The early monkey study provided basic evidence to initiate applying CIMT in humans. Thus, studies in animal models have potential to develop new treatment approaches in humans with neurological disease. Animal models also has been developed and used to test therapeutic treatment in other fields including psychology(Pawlak, Ho, & Schwarting, 2008; Shaffery, Hoffmann, & Armitage, 2003). Aniaml models of human psychopathology, such as depression and anxiety, have been contributed to understand biological mechanisms of individual behavior and emotional expression(Pawlak, Ho, & Schwarting, 2008). Animal model of depression provided positive neurobiological effects of enrichment environment, including social environment, on depression(Ilin & Richter- Levin, 2009). Also social stress induced depression-like behavior in animal model(Wu & Wang, 2010). Based on neurobiological and behavioral evidence, social-based intervention is applied to people with depression(Mason, Schmidt, Abraham, Walker, & Tercyak, 2009). Research in the animal model of a neurological disorder helps develop more effective intervention in humans. After neurological damage or pathological onset, the nervous system starts to change in various ways(Nudo, 1999, 2006a; Nudo et al., 2003; Plautz & Nudo, 2005). Animal studies have provided evidence to understand of these processes, including recovery process, in the neural system. A better understanding of neurological changes after a neural incident is helpful to develop therapeutic approaches in humans based on pharmacologic, cell-based, gene transfer, immune-based, and occupational therapeutic knowledge(Cramer & Riley, 2008; Heddings, Friel, Plautz, Barbay, & Nudo, 2000). Evidence has contributed to implement and design clinical trials to investigate the effects of treatment for neurological disease. Generally direct measurement of biological events, including cellular and molecular events, is not possible in humans(Cramer & Riley, 2008). In addition, researchers can investigate to find the important factors that improve effectiveness of interventions in animal models with controlling pathological degrees, biological factors and environmental factors. In the rat model of unilateral ischemic stroke, investigators compared motor skill training and voluntary exercises to find which training factor would enhance recovery after stroke(Maldonado, Allred, Felthauser, & Jones, 2008). In the primate model in which unilateral forelimb is surgically deafferented, researchers investigated minimal period of restricting movement of the intact upper extremity. When restricted after surgery, motor recovery improves in the deafferented limb(Taub & Uswatte, 2003). These animal studies contribute to human protocols. Thus, animal models have potential to improve the OT approaches for neurological diseases.

In summary, animal models of neurological diseases are essential to improve OT practice and theory. The animal models provide related knowledge for a better understand the mechanism of diseases and related neural networks. Based on this knowledge, researchers can test their hypothesis on neural disease. In addition, accumulated animal studies in neurological disease contribute to introduce the new approaches to human diseases and to improve the effectiveness of treatment. Therefore, animal models of neurological disease have the potential to improve OT theory and practice by providing evidence and a fundamental base for human transitional study in neurological disease.

## Ⅲ. Conclusion

The purpose of OT is to improve health and well-being in humans through engagement in occupations. However, it does not mean only human studies improve OT theory and practice. Animal models have contributed to improve OT theory and practice especially in neurological disease. Based on precise neurobiological data derived from experimental and methodical benefits, animal models support core OT theory which demonstrated positive effects of occupation and environment on the nervous system. Evidence from animal studies influences not only OT theory but also the practice approaches. Animal models improve CPMs by enriching the related knowledge especially with sound neuroscience and by providing fundamental structures for human transitional studies in neurological disease. Animal models for neurological diseases provide basic knowledge and evidence of neurological disease, contribute to modify the interventions to be more effective in humans, and provide evidence to design well built human studies. However, there were very few animal studies in OT area(Lane, 1998; Roughton, Schneider, Bromley, & Coe, 1998). Recently OT researchers have become interested in animal models for neurological disorders. They invented the Sensory Processing Scale for Monkey (SPS-M) to develop the nonhuman primate model of sensory processing disorder(Schneider et al., 2007). This kind of work contributes to build up OT approaches for SPD and provides related knowledge on SPD to OT researchers and practitioners. Animal model can be used to test various treatment repeatedly to develop optical approach. In future, researchers should investigate neurobiological effects of OT approaches in animal models of neurological disorder. Also therapists should more concerned with neurobiological evidence of animal study supporting therapeutic effects of OT approaches. These neurobiological evidence from animal studies will demonstrate which factors of OT treatment induce positive neurobiological changes associated to occupational performance, which will improve OT approaches for neurological disorders in humans. In conclusion, animal models of neurological disease are critical and have the potential to improve OT practice and theory in many ways. OT researchers need to pay more attention to animal models.

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## 국문초록

# 신경과학적 관점으로 본 작업치료에서 동물 모델의 필요성


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서론 : 동물 연구는 작업치료에 직접적으로 적용할 수 없으나, 인간을 대상으로 한 연구와 함께 작업치료의 이론과 임상에 필수적인 지식을 제공한다. 본 논문의 목적은 신경과학적 관점에서 동물모델이 작업치료의 이론과 임상에 어떠한 가능성을 가져다 줄 수 있는지를 살펴보는 것이다.

본론 : 동물 모델을 통해 얻은 지식은 뇌신경 질환의 기전과 관련된 신경 회로에 대한 이해를 돕는다. 이러한 지식을 바탕으로, 연구자들은 뇌신경 질환에 대한 여러 가지 가정들을 동물 모델을 통해 확인해 볼 수 있다. 또한, 여러 동물 실험들을 통해 쌓인 지식들은 인간에게 적용할 수 있는 새로운 치료적 접근들을 제시해 줄 수 있으며 치료에 대한 효율성을 높여줄 수 있다.

결론 : 동물 모델을 통해 얻은 지식은 뇌신경 질환의 기전과 관련된 신경 회로에 대한 이해를 돕는다. 이러한 지식을 바탕으로, 연구자들은 뇌신경 질환에 대한 여러 가지 가정들을 동물 모델을 통해 확인해 볼 수 있다. 또한, 여러 동물 실험들을 통해 쌓인 지식들은 인간에게 적용할 수 있는 새로운 치료적 접근들을 제시해 줄 수 있으며 치료에 대한 효율성을 높여줄 수 있다.



주제어 : 뇌신경질환, 동물모델, 신경과학