Short Communication
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Some findings on ants as models, which should be considered for caring of humans

Abstract

The harmful effects of many situations and substances used by humans have been studied using ants as biological models. Some results are of high interest for caring of humans. They are published, together with other results, in different journals, all along these last years. Consequently, they may have been not detected by concerned persons. In the present short paper, we summarize the most relevant ones, giving each time the initial reference, so that, this time, practitioners, pharmacists, and psychologists could have access to judicious information. These results concern, among others, electromagnetism, drugs, food additive, sweeteners, antidepressants, anxiolytics, and an analgesic

Keywords: aggressiveness, cognition, conditioning, dependence, electromagnetism, food consumption

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Introduction

Most of the biological and medicinal discoveries have been made working on animals as models. This concerns physiology, genetics, embryology and ethology. The models used were, among others, 'Escherichia coli, Saccharomyces cerevisae, Drosophila melanogaster, Apis mellifera, Rana esculenta, Ratus norvegicus, Mus musculus, Pan Troglodytes'. Working on ants as an ethologist and a physiologist since 1969, we became progressively conscious that these insects could also be used as models. Doing so, we made several findings which should be considered for caring of humans. Unfortunately, these findings are dispersed among many published works, in different journals, and each time related together with other results. They may thus have been not detected by concerned humans, practitioners and pharmacists. Therefore, we took the opportunity of being invited to submit a very short paper to the present journal MOJ Biology and Medicine for summarizing these weakly divulgated findings potentially useful for humans. Below, in this introduction section, we explain why ants can be used as models and what we can assess on them. Then, we briefly cite our methods, referring to previous works, and finally we listed our findings which could interest humans. Ants are eu social hymenoptera, highly evolved as for their resting position of their mouth parts, their numerous glands producing informative chemical signals, and their social organization.[1] They generally use a nest odor, a nest entrance odor, several area marking odors, a recruitment odor, a trail odor, and an alarm odor, as well as informative tactile and acoustical signal.[2] Callows learn these social signals.[3] Ants can navigate using memorized visual and olfactory cues, adequately recruit nestmates, expect the location and the time of food delivery on basis of previous deliveries, imitate nestmates, recognize themselves in a mirror, solve simple problems, learn novel behaviours,[4] but probably not use tools and not learn to do so [Cammaerts, unpublished data]. Also, several colonies containing hundreds of individuals can be maintained in a laboratory during entire years, at low cost. They are thus potential good models.

Working essentially on species belonging to the genus Mymica, we finally became accustomed to assess at least 22 physiological and ethological traits on these ants. These 22 traits are the ants' meat food consumption sugar water consumption, general activity, linear speed, angular speed, orientation to an alarm signal, trail-following, audacity, tactile (pain) perception, brood caring, cognition, aggressiveness against nestmates, aggressiveness against aliens, ability in escaping from an enclosure, visual an olfactory conditioning ability and memory, adaptation to a consumed product, habituation to the effect of a consumed product, dependence on a product, decrease of the effect of a product after is consumption was stopped. This panel of quantifiable traits allows defining, at least partly, the effects of situations or consumed substances on living organisms, and thus potentially on humans. It is exactly what we did for, until now, four situations and 23 substances largely used by humans. In the present work, we report only the most pertinent results which should be of interest for taking care of humans.

Material and methods

Collection and maintenance of ants

Ant colonies were collected on field and maintained in the laboratory 'in artificial nests made of 2–3 glass tubes half filled with water, a cotton plug separating the ants from the water'. 'The nest tubes were deposited in a tray (34cm x 23cm x 4cm), the internal sides of which were slightly covered with talc to prevent the ants from escaping. The trays served as foraging areas and food was delivered in them'. 'Food consisted of an aqueous solution of sugar (30%) permanently given in cotton plugged glass tubes (diameter: 1.5cm, length: 7cm), and of cut Tenebrio molitor larvae (Linnaeus, 1758) provided as necessary.' Laboratory temperature, humidity, lighting, electromagnetism was optimum for the collected species.

Experimental protocols

They are numerous, detailed when used for the first time and briefly related when used again for following works. It would be too long and boring to once more explaining them here. Interested readers are invited to find their description in the following previous works:[4–14] the last conducted one]. Briefly:

i. Food consumption and general activity were assessed by counting the ants eating and those being active.

ii. Linear and angular speed as well as the orientation towards an alarm signal were assessed by recording 40 ants' trajectories and analyzing them with an adequate software.

iii. Trail following was quantified through the number of arcs of 10 angular degrees the ants walked along a circular trail (R=5cm; 1 poison gland extract).

iv. Audacity was evaluated by the number of workers coming onto a risky apparatus.

v. Pain perception was approached through the ants' linear and angular speed on a rough, uncomfortable substrate.

vi. Brood caring was measured through the number of larvae, experimentally removed from the nest, the ants replaced in the nest over time

vii. Cognition was evaluated by the number of ants able to cross a path with twists and turns,

viii. Aggressive behavior was quantified by the number of five aggressive levels the ants presented in the course of dyadic encountering

ix. Ability in escaping from an enclosure was appreciated through the number of ants which could escape from an enclosure provided with a small exit notch

x. Conditioning ability and memory were evaluated by training the ants to visual or olfactory cues and testing then them in an Y apparatus provided with the cue in one of its branch

xi. Dependence on a substance was revealed through the ants choice between a sugar solution containing the substance and an identical sugar solution free of the substance.

xii. Adaptation as well as habituation to a substance was examined by assessing again a given ants' trait after several days of that substance consumption.

xiii. The decrease of the effects of a substance was studied by assessing a given ants' trait over time after weaning.

Result and discussion

Manmade electromagnetism

Using a duly programmed generator of the most used electromagnetic field, and working on six colonies of Myrmica rubra, we showed that exposed ants were severely impacted. They could no longer acquire conditioning, they lost their visual and olfactory memory, they less responded to their pheromones, they no longer recruit nest mates, they no longer took care of their brood, and they had difficulties in reaching the food sites and in re-entering their nest. Finally, all the colonies collapsed.[15] Manmade electromagnetism, which amplified in the course of time all over the world, may be one of cause of the bees' CCD. Several years after our observations on ants, it was demonstrated that electromagnetism affects all the biological organists, functions, mechanisms and physiological traits requiring electric elements, that is nearly all the vital functions of every living organisms (mitochondria, chloroplasts, cellular membrane, nervous system, and so on).[16]

Impact of activity and sugar consumption on conditioning ability

Working on three colonies of M. ruginodis, we observed ants having their food at 5cm from their nest reached a conditioning score of 85% and retained 75 of it, that ants having their food at 10cm from their nest reached 80% of conditioning and retained 65% of it, while that ants having their food at 15cm from their nest reached 75% of conditioning and retained 60% of it. Learning is thus of better quality when the general activity of the individual is not excessive. We also saw that ants receiving no sugar acquire no conditioning at all while those eating sugar were easily conditioned. Sugar is thus necessary for the brain functioning and for an efficient memory.[17] These two observations are valid for humans, especially for children.

Imitation is not enough for learning

Working on M. sabuleti, we discovered that naïve ants paired with previously conditioned congeners were very quickly conditioned, but entirely lost such a 'conditioning' as soon as the cue was removed.[18] This means that imitation exists in ants, and that such an ability is not enough in itself for truly learning. Thanks to imitation, an 'apparent' learning occurs, but personal learning must thereafter been made for effectively detaining the ability of correctly responding, the memory of what must be learned.

Dependence developed when quick decrease of effect occurs

Firstly observed while examining the effects of cocaine, then confirmed when examining the effects of twenty other products, dependence occurred always when the effects of the consumed product quickly decreased, at least for a time, after weaning. Individuals perceive that quick loss of effects and then want to consume again the product, this leading finally to addiction.[5] For treating addicted persons, the critical time period during which the loss of effect is rapid must be precisely known, and the persons must be then cared off, helped, and provided with derivatives. Note also that addiction (in humans! and proved in rats[19]) also occurred each time social problems exist. Only solving such problems, together with helping during the critical time period could save addicted persons.

Nicotine acts as a reward

Under that alkaloid consumption, the ants' cognition was perfect, but they cannot acquire any conditioning, what was illogic. We found the explanation with stupor. The ants reached 90% of conditioning score when rewarded not with food but with! nicotine!.[6] This substance 'takes' thus the place (physiologically, in the brain) of some reward, of pleasure, and nothing else gives rise to wellness. Persons addicted to nicotine must be helped. Also, it appeared that ants well fed never became addicted to nicotine, while starved ants immediately became so. This means that addiction to nicotine occurs when some problematic cause exists, and caring of addicted persons requires eliminating this problematic cause. Note also that the effect of nicotine rapidly decreased for a time after weaning, what allowed the development of addiction.

Large use of quinine has increased malaria dispersion

Working on M. sabuleti, we studied the effects of quinine, and finally the decrease of these effects after weaning. Effects of quinine vanished in 10 hours.[7] To be protected against malaria, humans ingest quinine every 24 hours. This is enough for avoiding the formation of schizontes (they develop in 3 or 4 days, causing then the tertian or quartan fever), and humans are thus protected and do not for die from malaria. But between 10 and 24 hours after quinine ingestion, gamontes can be perfectly formed, and the disease can be propagated during about 14 hours. This explained the large dispersion of that

illness, and practitioners helped by researchers must found any drug acting on gamontes development. Previous antidepressants are toxic (induce aggressiveness), present ones are weakly toxic but lead to dependence. We made this study in three steps on the ant M. Sabuleti.[8–10] The first kind of antidepressants used, the TCA, appeared to be the less toxic, slightly impacting the ants' behavior, inducing no aggressiveness towards nestmates, and leading to no dependence. The second kind of antidepressants used, the SNaRI, presented more adverse effects, inducing among others some aggressiveness against nestmates, and reducing cognition as well as conditioning ability and memory. However, it did lead to addiction. The third kind of antidepressants used, the SSRI, the most used active substance being fluoxetine, was very toxic. This substance induced strong aggressiveness against nestmates, and decreased brood caring, olfaction, learning, memory and food consumption among others. It did not lead to addiction, but, after two months under that substance diet, all the experimented colonies died. The later on and still nowadays used SSRI antidepressants, the active substance of which is generally paroxetine, are far less toxic. Paroxetine had somewhat less adverse effects, and less strong ones. Nevertheless, paroxetine induced akathisis, affected cognition and memory, induced some aggressiveness against nestmates, but the experimented colonies never died. However, this substance lead to obvious dependence and after weaning its effects rapidly decreased for a time. Humans using this current antidepressant will thus become dependent on it, and weaning will be painful.

Sweeteners increase food consumption

In general, such substances (we studied aspartame and sucralose) impacted behavior (essentially learning ability, food consumption, brood caring behavior) because they give to the brain the information of sugar presence in the body though, in reality, there is no or very few sugar intake.[11] For consuming less sugar and avoid adverse effects of sweeteners, humans should used a mixture of a large amount of true sugar and a very small amount of a tasty sweetener. They can also consume a large amount of stevia, a natural low caloric not tasty sugar mixed to a very small (about 0.1%) amount of a nice, tasty sweetener (for example, sucralose) (ref, ref)

Glutamate monosodium should be avoided

This food additive is largely used in Asian populations. On ants, it increased the meat food consumption, and decreased the precision of reaction, cognition, learning ability, middle term memory, thus traits requiring perfect functioning of the brain and the nervous system.[12] It indeed hydrolyzes into glutamic acid, a neurotransmitter which may become harmful. Glutamate consumption should thus be limited, essentially at the same time as aspartame, a sweetener also producing neurotransmitters.

Alprazolam leads to dependence; a safe natural product should be used instead of it. This substance acts as an anxiolytic. Unfortunately, tested on ants, it appeared to reduce the food consumption, general activity, locomotion, audacity, cognition and tactile perception. It also induced aggressiveness against nest mates and leads to dependence.[13] All this incites us to recommend the use of sedinal plus®, a safe natural mixture of four adequately chosen plants.[14]

Statins impact the health; a safe natural product should be used instead of them

These substances are used for treating persons suffering from hypercholesterolemia. It appeared that simvastatin affected the ants' locomotion, larvae loading, sugar food consumption, cognition, conditioning ability and memory.[20] Statins should thus be used only in case of severe hypercholesterolemia, and less serious cases should be treated thanks to a safe natural product, the red yeast of rice.[4] Paracetamol (analgesic) impacts the central nervous system. This analgesic is nowadays suspected to act on the central nervous system.[21] Effectively, woks on ants revealed that paracetamol largely decreased the conditioning ability (so the short and middle term memory), the cognition, the orientation and the trail-following capabilities. Moreover, ants presented only some slight adaptation to that drug, but an obvious habituation to its analgesic effect and a dependence on its consumption (this later trait resulting from a very quick loss of effect after weaning).[22] Humans will thus be inclined to consume again paracetamol and to ingest more amounts for obtaining similar effect. This is not in favor of that drug used, and natural, safe, product should be researched (f.i. an alcoholic extract of curcuma).

Conclusion

Three ideas emerged from our studies on the effects of substances or situations, using ants as models. First, each time, we found effects similar to those already known in humans or other animals, we could precise and quantify these effects, and we revealed other not yet known which may exist for humans. We can thus admit that ants are excellent biological models, being moreover easily maintained in a laboratory, and offering many ethological and physiological traits to examine. Secondly, our findings on ants were very probably not detected by practitioners, pharmacists, or psychologists. He reason is that there exist on one hand scientific journals devoted to humans' health and, on the other hand, journals which deal with experiments on animals. We cannot but laud the existence of the present journal devoted at the same time to biology and medicine. In the course of our studies of the effects of substances, when making the bibliography concerning the studied substance, each time, we became conscious that the first works made were either made with some conflict of interest, or were not or not adequately divulgated. Several years elapsed before the verity became available for anyone wanting to use the concerned substance. Such a 'perfidy' still exists nowadays, for drugs, food complements, food additives, wireless technology.

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Conflict of interest

The author declares no conflict of interest.

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