

Opinion piece



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Animal behaviour

An opinion on the interpretation of social release in rats

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This commentary concerns a controversial animal model in rodent social release research wherein one rat releases another rat from entrapment in a plastic tube. Release from the plastic tube has been proposed as a model to study empathically motivated behaviour. However, empathic motivations have been contested by others who have provided evidence for social reinforcement motivating release behaviour. Furthermore, helping, or other forms of pro-social behaviour could exist independent of empathy or empathetic motivation and the stimuli occasioning this helping behaviour are not known. In addition, there is a dearth in the citations of published studies whose results fail to support this model. In other words, the controversial aspect of the rodent social release model is often overlooked. This controversy is described in the current opinion piece.

New animal models of social behaviour, including those potentially motivated by empathy, are certainly needed [1,2]. That being so, it is still problematic when a higher-order cognition is used to explain animal behaviour that could arise from much simpler processes [3]. Empathy is one psychological construct that some researchers suggest is motivating behaviour in the social release paradigm (i.e. one rodent releasing another from entrapment) to explain the observed behaviour. However, using the social release paradigm to study empathically motivated altruistic behaviour is controversial, and reports suggesting more simple interpretations have not adequately been addressed by the proponents for the model. To the author, there seems to exist a citation bias, in which the proponents of a simpler explanation of rodent social release (e.g. variants of social reinforcement) are often not included or discussed in papers that claim empathic/pro-social motivations. The aim of the current paper is to describe the controversy and the evidence for and against the model to study empathetically motivated altruistic behaviour in rodents.

Historically, several studies seemed to indicate the existence of empathically motivated behaviour in rats such as responding to stressful sounds from conspecifics [4] and pressing levers to release conspecifics from stressful situations [5]. However, with the advent of social neuroscience in the 1990s [6], the interest grew in animal models of social behaviour, such as those motivated by empathy. In 2011, Bartal *et al.* [7] showed how one rat would open a small door in a plastic tube to release a trapped conspecific, seemingly without any other motivation than the release of the trapped rat. The rats would also continue to open the door when the trapped rat was released into a separate compartment that prevented socialization. Some rats would even open the tube with a conspecific, rather than one containing food (chocolate pieces). Bartal and colleagues assumed that being trapped was distressing, as it was known that restraint resulted in an increased stress response (e.g. increased immune response, heightened levels of corticosteroids, as reviewed in [8]). However, the restraint used by Bartal *et al.* [7] was quite different from that

used to examine physiological changes in response to stress [8]. For instance, restraint stress studies do not usually include social situations, or the release from the restrainer to interact with another rat. Rodent helping behaviour in the social release paradigm seemed a direct extension of early research, but it is worth noting here that early research [4,5,9] did not mention empathy. The approach was more focused on observable behaviour as seen in the research of Rice & Gainer [5], which did not make any claims of empathy. Instead, altruism was operationalized as 'behaviour of one animal that relieves another animal's 'distress' [5, p. 123]). This behaviour-focused approach reflected the behaviouristic psychology at the time, and similarly, modern psychology research reflects modern theories where cognitive abilities such as empathy are claimed to exist in non-human animals, albeit in different and simpler variants [10]. However, the claim of empathically motivated rodent behaviour raised in Bartal *et al.* [7] was quickly challenged.

Vasconcelos *et al.* [11] pointed out that helping behaviour could occur without any sharing or understanding of emotions between the rats. Silberberg *et al.* [12] demonstrated that door opening is an operant reinforced by social reinforcement combined with neophobia (that the trapped rat fears the plastic tube, and thus exits upon opening, but that this stops after a few sessions). Those authors documented social reinforcement with the demonstration that if rats did not have a previous history with socialization, they would not open the restrainer to release a conspecific [12]. These social reinforcement effects were later replicated by Hachiga *et al.* [13]. Rats do not prefer to enter a box to release a trapped rat compared to just entering a box with another rat, but they do prefer entering a box with a rat rather than an empty box [13]. Additionally, Hiura *et al.* demonstrated the functional role of social reinforcement in that lever press response continued for both socialization and food '...albeit at substantially higher levels for food than for social access. Responding for social access decreased to low levels under extinction conditions, demonstrating functional control by the social reinforcement contingency' [14, p. 37]. Later, Hachiga *et al.* [15] showed that being in the plastic tube could be rewarding for the trapped rat, which is problematic for the empathy explanation: if entrapment does not cause distress, release cannot be considered pro-social. Others documented that opening to access food occurs faster than opening to release a conspecific if the rat is food-deprived and trained to the opening behaviour [16], which is not in itself a counter to an empathic explanation but certainly a sign of competing motivations for opening. Lastly, Heslin & Brown [17] showed that rats do not show a preference for pro-social helping if they are given the option to just socialize without helping, which indicates a smaller role for empathic motivations than in the original paper [7].

Similar events occurred after publications of a variant of the social release design in Bartal *et al.* [7]. In that design, one rat was trapped in a waterfilled compartment, and another rat could open a door to release the soaked conspecific [18]. The authors proposed that opening to release the soaked rat was pro-socially motivated [18], but once again critical voices presented another explanation that did not rely on an inference of empathy [19]. This time Schwartz *et al.* [19] showed that the release of the trapped rat was maintained by '(a) the social contact offered by the released rat, and (b) the reinforcing value of proximity to a pool of

water' ([20], abstract). In other words, both Schwartz *et al.* [19] and Silberberg *et al.* [12] showed the importance of social reinforcement within different variants of the social release paradigm. Furthermore, Kalamari *et al.* [20] recently observed a reduced motivation to open the door with a trapped rat, compared to when there was no trapped rat. It is perhaps not surprising then that in mice similar opening-to-release behaviour was first described as helping [21], comparable to Bartal *et al.* [7] before it was shown that the mice were just interested in the restraining device [22]. In summary, it is not known exactly what triggers the opening of the tube to release the trapped rat, but effects of social reinforcement are thoroughly demonstrated. In fact, it could be a multitude of motivating variables [23]. As of now, a detailed description of preceding stimuli that could occasion opening behaviour in the social release paradigm is missing [24]. Without this detailed description, no conclusion can be drawn as to what the opening behaviour should be called; empathically motivated and pro-social or something else.

Even so, the controversy regarding why opening behaviour occurs in the social release paradigm is not portrayed in most research building directly on, or at least citing, the original paper (i.e. [7]). It must be mentioned that criticism raised by Silberberg *et al.* [12] was partially addressed in their original paper with the demonstration that the maintenance of opening was largely independent of socialization [7]. Nonetheless, the rats in that study did have experience with socialization after opening before they were tested [7]. It could be said that rather than countering the critique, Bartal and colleagues demonstrated the importance of order in the research design. Rats with no experience of socialization will not open, but once they have experience with socialization post-opening, this opening will be maintained even when socialization is not possible afterwards. The author has not found any other counters from Bartal *et al.* to the claims of social reinforcement effects in the social release paradigm in their most recent experimental publication [25]. There is no reason to speculate as to why critics are not included in the mentioned paper, none the less, it is a citation bias that is echoed by others who employ the social release paradigm.

Others expanded studies of rodent social release by including the effects of opioids [26]. Tomek *et al.* [26] include two of several papers that are critical to rodent empathy (i.e. [14,20]) but state that '... there is no universal agreement as to whether these behaviours are expression of empathy-like or social contact motivated behaviours. Regardless, we assert that such behaviours can be viewed as representative of pro-social functioning' ([26], p. 682). In the author's opinion, asserting that pro-social functioning is a correct description of door opening in the social release paradigm does not take into consideration the previously mentioned critical papers (e.g. [11,13,14,20]). This becomes more concerning in their follow-up paper where there is no commentary at all on the controversy concerning why rats release trapped conspecifics [27]. That the controversy is not mentioned is striking considering that Tomek *et al.* [27] cites research that asserts and demonstrates the effects of social reinforcement (i.e. an alternative explanation to pro-social/empathic motivations) in a similar rat release paradigm [14]. Carvalho *et al.* [28] look at rodent social release when escape is an option, in an adaptation of [7]. The authors do add a citation to relevant critics of the empathy explanation, but it is done in a manner that severely underplays the existing controversy by stating that Bartal *et al.* [7]

'...excluded social interaction as a motivating factor behind helping behaviour (but see Hachiga *et al.* [13]; Schwartz, Silberberg, Casey, Kearns, & Slotnick, [19]; Silberberg *et al.*, [12]), given that the free rat still opened the door even when contact with the cagemate was prevented' [28, p. 453]. That the rat continues to open when contact was prevented does not prove empathic motivations; continued opening could be due to learning history, interest in the door opening mechanism, social stimuli from the trapped rat (odours, sounds etc.) and perhaps other reasons also not linked to empathy. Carvalheiro *et al.* does not discuss social reinforcement, and empathy and pro-social behaviour are not further problematized. Shinozuka *et al.* [29] is similar; that paper describes social modulation of behaviour in rat models of cerebral stroke. No mention is made of any controversy regarding the empathy capabilities of rats, instead, Bartal *et al.* [7] is solely used to prove that rats do indeed show empathy [29]. A recent review by Cho *et al.* [30] on translational studies of pain takes the same approach, stating that '...evidence for empathy in rodents shows that mice and rats consistently imitate arousal states and behaviours of one another; they will even sacrifice personal gain to relieve the distress of a fellow rodent' [30, p. 9]. Cho *et al.* [30] cites only Bartal *et al.* [7] from social release research and no sources critical of the rodent empathy claim. Similarly, Yamagashi *et al.* [31] make use of the same design as Sato *et al.* [18] with the soaked and stressed rat and investigate the effect of oxytocin. There are no citations of any research that indicates anything other than empathic motivation for rodent helping behaviour [31]. Closely related, in expansions into rodent bystander effects by Havlik *et al.* [32] only the side of empathy is given any space at all, and effects of social reinforcement are missing. A problematic consequence is that the research literature building upon studies that explain social release with empathic motivation lacks control conditions such as interest in the restrainer, social reinforcement and avoidance of aversive stimuli.

Should a novice researcher in animal models of social behaviour begin with reviews of such behaviours, most will tell the same tale as the research described in the previous paragraph; there is no discussion regarding the empathic capabilities of rats. Many of these reviews, probably due to their focus on empathy or helping, do not present other explanations such as social reinforcement (e.g. [33–40]) (but see [41], for an acknowledgement of the many factors influencing social release). While it is true that a single animal model makes up a small part of a full review on a topic such as empathy in rodents, it is not a proper representation of the current scientific climate if no other publication with different explanations for the observations is included.

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So far, this opinion piece has addressed the citation bias in the controversial rodent social release research, but there is an inherent problem with the empathy explanation for social release. Separate from the argument that social reinforcement may be a likely driver of the door opening in the social release paradigm, the measure of behaviour (i.e. latency to open the door and rate of opening) does not demonstrate that empathy is the proximate mechanism for door opening/release behaviour. Explaining behaviour with cognitive theories (i.e. empathy) seems a trend in comparative research, even when simpler explanations (i.e. social reinforcement) could suffice [3]. The popularity of cognitive theories also extends to the media; empathic rats have been described in larger news outlets such as the Washington Post [42] and Wired [43]. While popularity should not be a measure of success for scientific theories, it can certainly influence funding even if the scientific basis is heavily debated.

Lastly, this commentary is merely a summary of an existing controversy that, in this author's opinion, does not seem to be getting much attention. I will not guess why any of the mentioned papers, reviews or chapters do not cite papers that are either critical or demonstrate other relevant factors influencing social release in rats. However, if we do not look at all the findings, there is no way forward to a correct and detailed understanding of the observation originally described by Bartal *et al.* [7]. The case of the social release paradigm is perhaps not singular, as it has been pointed out that cognitive explanations are not always given enough critical treatment. Instead, cognitive constructs (i.e. empathy) are preferred over explanations based on simpler processes [3]. Nonetheless, the call for better animal models of social behaviour [1,2] should be answered properly, even if it takes time and requires a re-examination of our points of view. For the social release paradigm, a proper answer to why a rat would open a plastic tube when another rat is inside requires us to know which exact stimuli play a causal role in the opening behaviour [24]. This is currently not known, and thus the claim of empathic motivation does not seem fully supported. Researchers using this animal model should therefore take greater care to cite relevant papers, especially those critical towards the original claims of rodent empathy.

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