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Personal messages reduce vandalism and theft of unattended scientific equipment

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Summary

1. Scientific equipment, such as animal traps and autonomous data collection systems, is regularly left in the field unattended, making it an easy target for vandalism or theft. We tested the effectiveness of three label types, which differed in their information content and tone of the message, that is, *personal*, *neutral* or *threatening*, for reducing incidents of vandalism and theft of unattended scientific field equipment.

2. The three label types were attached to 20 scientific equipment dummies each, which were placed semi-hidden and evenly distributed in four public parks in Munich, Germany.

3. While the label type had no effect on the severity of the interactions with our equipment dummies, the *personal* label reduced the overall number of interactions by *c.* 40–60%, compared with the dummies showing the *neutral* or *threatening* label type.

4. We suggest that researchers, in addition to securing their field equipment, label it with personal and polite messages that inform about the ongoing research and directly appeal to the public not to disturb the equipment. Further studies should extend these results to areas with different socio-economic structure.

Key-words: crime prevention, damage, equipment protection, information, message, mode of address, public information, scientific field equipment, signage

Introduction

In ecological field studies, the use of field deployable equipment is common. This equipment includes simple (live) traps, for example, for mammals (Fitch 1950; Riem *et al*. 2012), birds (Tordoff 1954; Campbell *et al*. 2012), reptiles (Reed *et al*. 2011) and insects (Irish *et al*. 2013), but also exclosures (Kalka, Smith & Kalko 2008) or mesocosms (Zhou *et al*. 2012) as well as automated data acquisition devices, for example, for radio-telemetry (Holland, Borissov & Siemers 2010), bioacoustic recordings (Griffiths 2007) and visual wildlife monitoring (Ng *et al*. 2004). This kind of equipment is regularly left unattended in the field and therefore vulnerable to vandalism and theft.

Despite its putative occurrence, information about vandalized scientific equipment is not regularly published or systematically collected, but see Creed & Amado Filho (1999) reporting "'helpful' tourists 'cleaning up' markers" and two studies mentioning the theft of camera traps (Haas 2000; Lyren 2001). To close this gap, we contacted researchers via two e-mail list servers (ECOLOG-L and EvolDir) and personally. We received 61 reports on various types of field equipment being stolen, damaged or otherwise vandalized around the world, reporting only one incident within decades of meteorological surveys to a loss of more than 50% of cameras within 3 months, with incidents not necessarily being correlated with applied protection measures (see Table S1, Supporting information). Note, however, that we also received 15 reports of no incidents at all and that this list cannot be representative and only aims to characterize the potential range of incidence frequency, type and impact. In summary, cases of vandalism or theft may be rare, yet they do occur, and each single incident has the potential to disturb or even jeopardize field-based data collection.

Not only scientific equipment is vulnerable to vandalism or theft, but also objects in both the public and private sectors, including schools (White & Fallis 1980; Tygart 1988), nature reserves (Winter 2006), urban parks (Yavuz & Kuloglu 2010) and construction sites (Boba & Santos 2007, 2008). Potential mitigation methods to reduce vandalism of scientific equipment can be derived from experience in these areas and by considering potential factors facilitating this behaviour, including the vulnerability of potential targets and the opportunity and personal likelihood for deviant behaviour (Clarke 1983; Felson & Clarke 1998). Information signs displaying written messages, symbols and pictures, are regularly used in (semi-) public spaces to reduce deviant behaviour, potentially by influencing the perceived opportunity and the personal likelihood (McNees *et al*. 1976; Winter 2006; Powell, Roberts & Nettle 2012). The success of the communication and its influence on the behavioural response of the addressee depend on the wording of the written information (Hall, Ham & Lackey 2010),

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with Winter (2006) and Cialdini *et al.* (2006) obtaining most success with messages that tell visitors what not to do, and the mode of address (Chandler 2007), that is, the way and tone how an addressee is addressed by the sender (Winter 2006; Skibins, Powell & Stern 2012). Pictorial information, such as pictures of eyes, is powerful by affecting people's subconscious minds and consequently their behaviour (Burnham 2003; Oda *et al.* 2011) and lead to a 62% reduction in bicycle thefts (in combination with written information; Nettle, Nott & Bateson 2012) and an increase in charitable donations (Powell, Roberts & Nettle 2012).

Although field researchers regularly apply protection measures to their equipment, for example by securing it to solid, heavy and immobile structures (Fiehler *et al.* 2007) or by hiding and camouflaging (Jackson & Hutchison 2009; also see Table S1, Supporting information), a systematic test of their effectiveness has, to our knowledge, not been published. As information signs have proven successful in various settings, are inexpensive, easily applicable and can be added to almost any scientific equipment in any experimental situation, we tested their effectiveness in a field experiment. We left scientific equipment dummies unattended and unprotected in four public parks, and tested the effect of different label types that differed in the mode of address and tone of the message on the number and category of interactions by park visitors with the dummies.

Materials and methods

STUDY SITES

The experiment was conducted in Munich, Germany, in July 2012 under licence by the local park authorities and police departments. Prior to the experiment, we counted the number of people in various urban park-like areas, which were similar in vegetation cover and path accessibility, and chose four public parks that were about equally frequented during the afternoon. They were, in the order of data collection, *Englischer Garten* (*c.* 48°9′15″ N, 11°35′40″ E), *Pasinger Stadtpark* (*c.* 48°8′35″ N, 11°27′16″ E), *Maximiliansanlagen* (*c.* 48°08′ 20″ N, 11°35′42″ E) and *Flaucher* (*c.* 48°6′15″ N, 11°33′19″ E). Experiments were conducted about 300 m around the stated coordinates. *Englischer Garten* and *Maximiliansanlagen* are neighbouring parks, separated by several blocks of buildings and the river Isar. The beeline distance between the two closest points of the areas used for the experiment in these parks was 1·2 km, and 2·2 km between the two furthest points. *Flaucher* is also located along the river Isar at a distance of *c.* 5–6·4 km south of the former two parks. *Pasinger Stadtpark* is located 8·6–10·5 km west of the former three parks. All parks are used by citizens both for recreational purposes and commuting. They are covered by grass, bushes and trees with herbaceous and shrubby undergrowth and crossed by multiple paths along which we semi-hid our equipment dummies (Fig. 1).

EQUIPMENT DUMMIES

When designing the scientific equipment dummies, we considered four characteristics of potential targets of vandalism or theft: *value*, *inertia*, *visibility* and *access* (Felson & Clarke 1998). We prepared black plastic tool boxes (i.e. light weight, thus low inertia) with a blue handle and latch (high visibility; CALIBER N12S, R.G. Vertrieb, Küstriner Vorland Ot Manschnow, Germany) to resemble potential scientific data recording devices by fixing a fake dome camera with a flashing red LED (First Alarm Dummy Camera, A. I. & E., Eindhoven, the Netherlands) and a small black car antenna (Alu Antenne Citroen, Raceland GmbH, Herten, Germany) on top of each box (Fig. 2a). Gaps between the camera dummy, the antenna and the box were sealed with black and transparent silicone to create the impression of humidity-protected electronics (i.e. high value). Dummy visibility and accessibility was additionally ensured by placing the dummies half-hidden in the vegetation along frequented paths (see below).

LABELS

We designed three different types of labels, consisting of laminated paper (4 × 12 cm; Fig. 2b). All labels stated that this device was property of the Max Planck Institute for Ornithology in Seewiesen, part of an experiment, and gave the contact information of one of us (HRG). The three label types differed in the design and tone of the additional messages on the label, which were designed as *personal*, *neutral* or *threatening*. The *neutral* label was designed to provide information in a neutral and impersonal voice. Its central text asked not to touch the box. The label depicted a black-and-white warning sign as contextual cue below the text.

The *personal* label aimed to establish a personal, empathic relationship with the reader. Its central text also asked not to touch the box, yet the remaining text was more detailed compared with the other labels and directly addressed the reader in a personal voice. It indicated that the dummy was part of a final thesis, suggesting that a student might be conducting the experiment and directly offered to call for more information, giving contact details without academic degree. The photograph of a juvenile squirrel served as a contextual cue, which might be interpreted as the study species or induce further empathy due to the effect of the baby schema of juveniles (humans and animals) on adults (Lorenz 1943; Sternglanz, Gray & Murakami 1977; Glocker *et al.* 2009). This could reduce the disposition for an offence, as emotions play a role both in rational (Damasio 2006) and economic (Bosman & van Winden 2000; Bosman, Sutter & van Winden 2005) decision-making, even in groups (Bosman & van Winden 2002).

The *threatening* label was designed to increase the perceived risk of interacting with the devices, while keeping an impersonal voice. The label's central text threatened that each theft would be reported to the police. At the bottom, it depicted a warning text stating that the devices were GPS tracked. Both the GPS warning and the camera might induce the feeling of being monitored (Poyner 1991; Felson & Clarke 1998), thus increasing the perceived risk.

EXPERIMENTAL DESIGN AND DATA COLLECTION

In each park, we placed a total of 60 equipment dummies for (maximally, see below) 1 week in a semi-hidden fashion along the paths (i.e. ensuring good accessibility and medium visibility). Each label type was attached to 20 dummies, using an alternating order in the sequence of *threatening*, *neutral* and *personal*, so that every third dummy was labelled with the same type. While placing each dummy in the vegetation, we positioned two pebbles on marked locations inside the dummy, then closed the lid and the latch and sealed the dummy with a cable tie to which we attached the label. Depending on the available vegetation and visibility from the paths, we placed the dummies in distances of

Fig. 1. Examples of the field situation. (a) Typical view of a park, here: *Englischer Garten*. (b) Partially hidden equipment dummy in the vegetation along a path.

0·2–5 m to the path and 5–20 m between each other. All boxes were numbered to allow identification.

In each park, we placed the dummies during late Monday afternoon/early evening and conducted data collection between Tuesday afternoon and the subsequent Monday afternoon. Every afternoon between 14:00 and 17:00 h, we rated the weather subjectively as *rainy*, *cloudy* or *sunny* and counted the number of passing people for two hours, without distinguishing between different activities (e.g. walking, running, cycling). We then checked every dummy for signs of one of six predefined potential interaction categories (Table 1): we noted a dummy as *stolen* if we could neither find it at its original location nor anywhere else in the park, and as *relocated* if we found it away from its original position. We defined a dummy as *damaged* if any part of the dummy was broken or missing; as *opened* if the cable tie was broken and the lid opened; and as *opening attempt* if the latch was opened, but the cable tie intact and the lid closed. We classified dummies as *moved* (i.e. handled) if they were intact, but were found lying on their side. Dummies that seemed untouched were carefully opened, and if the pebbles inside had moved from their original marked locations, we also classified them as *moved*. Note that we could not determine how a dummy had been moved, for example purposefully, accidentally or by an animal. When we found signs of several different interactions on one dummy, we noted the most severe of them (see Table 1). After checking each dummy, we realigned the pebbles inside, closed and sealed it with a new cable tie, reattached its label and replaced the dummy in its original position. Stolen or damaged dummies were replaced with new ones with the same numbers and label types. After 1 week, all dummies were collected and placed in the next park.

DATA ANALYSIS

We counted interactions with the equipment dummies and the number of passing people for 7 days at *Flaucher* and *Maximiliansanlagen* and for 6 days at *Pasinger Stadtpark*. Interaction counts of the seventh day at *Pasinger Stadtpark* were excluded from the analysis due to a lack of people counts from the same day. In *Englischer Garten*, we collected data only for 3 days, after which the experiment had to be aborted because park visitors perceived the dummies as potential bombs.

We conducted the statistical analyses in R version 3·0·1 (R Development Core Team 2013), using the package *lme4* (Bates, Maechler & Bolker 2013) to compute generalized linear mixed-effects models (GLMM), fit by the Laplace approximation, with Poisson distributed errors for the count data (number of interactions). We chose the Poisson distribution because we knew only the number of dummies that had been interacted with, but not the number of dummies that had been seen but *not* interacted with. We estimated the effects of the factors by fitting a full model with all likely parameters and stepwise excluding those that did not contribute to the variance in the data. The full model included label type and interaction category as fixed effects and the interaction between label type and interaction category to test for an effect of the label type on the severity of interactions. Random effects were the park as a blocking factor nested in days as the repeated-measures term, the number of people (which likely influenced the number of encounters with the dummies), the day of the week and the weather category. We compared the nested models with the likelihood ratio test (Lewis, Butler & Gilbert 2011) with a chi-squared statistic and considered the common information criteria (AIC, BIC, deviance, log-likelihood). The minimal adequate model (Table 2) included the label type and interaction category (fixed effects), the blocking factor park nested in days and the number of people (random effects), and had the lowest AIC and BIC of all computed models, equal log-likelihood to two more complex models (which included weather and day of the week) and equal deviance to the next complex model (which included weather). For multiple comparisons of the fixed-effects parameters, we performed simultaneous tests for general linear hypotheses with Tukey's contrasts and a ζ-statistic with the package *multcomp* (Hothorn, Bretz & Westfall 2008) and present single-step adjusted *P*-values.

Results

The number of people per hour ranged from 92 on a rainy Tuesday in *Englischer Garten* to 244 on a sunny Friday at *Flaucher*, with a median of 149 (135–169 interquartile range). Summed over all the three label types and all the four parks, we counted a total number of 162 interactions with the equipment dummies (Fig. 3). The most frequent interaction was moved (98 of 162, 60%; multiple comparisons for general linear hypotheses with Tukey's contrasts, all $|\zeta| > 6$, all $P < 0{\cdot}001$). *Relocated* was the second most frequent interaction ($N = 20$, 12%), which was significantly more common than *opened*, the least frequent interaction ($N = 4$, 2%; $\zeta = 2{\cdot}924$, $P = 0{\cdot}036$).

Summed over all parks, we counted 36 interactions with the *personal* label, and 59 and 67 interactions with the *neutral* and *threatening* label, respectively. The label type had a significant effect on the total number of interactions (likelihood ratio test, $\chi^2 = 10{\cdot}161$, d.f. = 2, $P = 0{\cdot}006$), with the *personal* label having 39% less interactions than the *neutral* label (multiple comparisons for general linear hypotheses with Tukey's contrasts, $\zeta = 2{\cdot}325$, $P = 0{\cdot}052$) and 46% less interactions than the *threatening* label ($\zeta = 2{\cdot}991$, $P = 0{\cdot}008$). There was no significant difference in the total number of interactions between the *neutral* and *threatening* labels ($\zeta = -0{\cdot}709$, $P = 0{\cdot}754$). The statistical interaction between label type and interaction category was not significant (likelihood ratio test, $\chi^2 = 8{\cdot}602$, d.f. = 10,

Fig. 2. Equipment dummies and labels. (a) Experimental equipment dummy with a personal label attached to the cable tie. (b) The three label types, *personal*, *neutral* and *threatening*. English translation of the text: Header on all labels: 'Property of the Max Planck Institute for Ornithology, Seewiesen.' *Personal*: 'Part of my thesis – Please do not touch – Please call me if you have any questions and would like to know more:' and a photograph of a juvenile squirrel. *Neutral*: 'Part of an experiment – Please do not touch – For information:' and a warning sign. *Threatening*: 'Part of an experiment – Every theft will be reported to the police! – For information:' and the note 'GPS monitored!'.

$P = 0{\cdot}570$), thus the label type did not influence the type and severity of interactions with the dummies (Table 3).

These results essentially did not change when the most frequent interaction, *moved*, was omitted from the analysis. After excluding *moved*, the number of interactions with the personal label ($N = 10$) was reduced by more than 60% compared with the *neutral* and *threatening* label ($N = 27$ each; $\zeta = 2{\cdot}66$, $P = 0{\cdot}021$). Likewise, the statistical interaction between label type and interaction category remained non-significant (likelihood ratio test, $\chi^2 = 5{\cdot}463$, d.f. = 8, $P = 0{\cdot}707$).

Discussion

THE LABEL EFFECT

The labels differed from each other in multiple written and pictorial parameters because we aimed to achieve maximum protection, not to study the contribution of each parameter. As multiple parameters covaried, we cannot distinguish their relative contribution, particularly if visitors were more responsive to the written or pictorial information. We assume that the combination of the *personal* label's direct mode of address in a friendly tone, the implicit information about the experimenter and the squirrel photograph connected the reader more to the experimenter, both through the amount of information and through personalization or perspective taking (Preston & de Waal 2002), making this labelling more effective than the tone and information provided by the other labels. As the interactions with the *neutral* and *threatening* labelled dummies did not differ, the added threat of the *threatening* label had no additional effect. Possibly, the threat was not effective because the likelihood of punishment was perceived as too low to affect the reader's behaviour (Fox & Spector 1999). Otherwise, the threatening label might have had multiple opposing effects. The unfriendly authoritarian tone might have reduced readers' acceptance of the (implicit) request on the label (i.e. 'do not steal this device'), while the information of being GPS monitored might have suggested a high value of the dummy due to its apparent high protection.

In contrast to the number of interactions, the frequency distributions of the interaction categories and thus the severity of interactions did not differ between the label types. People who decided on encounter with a dummy (and its label) to interact with it, despite the request not to do so, were thus equally likely to conduct a certain interaction, regardless of the label's information and mode of address.

NUMBER AND TYPE OF INTERACTIONS

Despite our focus on the people's interactions with scientific equipment, it is important to note that most of our equipment dummies were untouched throughout the experiment. Out of 1380 potential interactions (60 dummies × 23 days), we counted only 162 interactions (12%). The maximum count for any label type (*threatening*) was 67 interactions out of 460 potential interactions (20 dummies per label type × 23 days; 15%). The maximum daily count reached 26 interactions (43% of 60 potential interactions). We deem it unlikely that many dummies remained unnoticed as they were well visible from the paths. It is more likely that many people noticed the dummies, yet either took no interest in them at all or read the label and inspected the dummy without interference. We deliberately refrained from utilizing security measures like camouflaging, hiding or chaining the dummies, because we wanted to maximize their vulnerability. Under more realistic conditions,

Table 1. Definitions of the interaction categories, in descending order of severity

Interaction	Definition
Stolen	Dummy neither found at original position nor anywhere else
Damaged	Completely or partly broken, for example camera dummy and/or antenna removed
Opened	Cable tie broken, latch and lid opened
Opening attempt	Cable tie intact, latch opened and lid closed
Relocated	Dummy removed from original position, but found either in close proximity or somewhere else in the park
Moved	Both pebbles inside the dummy not in their original position

Table 2. Parameter estimates and test statistics of the minimal adequate generalized linear mixed-effects models. AIC: 327·6, BIC: 375·9, log-likelihood: –151·8, deviance: 303·6, 414 observations with data of 23 days and four parks

Random effect	Parameter	Variance	SD	Correlation
People count	(Intercept)	0·18880545	0·434517	
Park (nested in day)	(Intercept)	0·01950954	0·139677	
Park (nested in day)	Day (slope)	0·00063107	0·025121	1·000

Fixed-effect level	Estimate	SE	ζ value	Probability (>|ζ|)
(Intercept)	−1·9092	0·3539	−5·395	6·85e-08
Personal	−0·494	0·2125	−2·325	0·0201
Threatening	0·1272	0·1794	0·709	0·4785
Moved	2·1871	0·3195	6·845	7·67e-12
Opened	−1·0116	0·5867	−1·724	0·0847
Opening attempt	0·03102	0·3989	0·778	0·4368
Relocated	0·5979	0·3772	1·585	0·1130
Stolen	0·2412	0·4049	0·596	0·5514

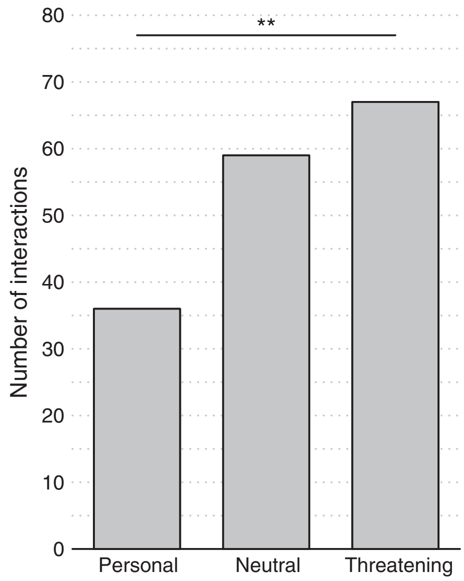

Fig. 3. Total number of interactions with the equipment dummies per label type. The bars show the total number of interactions for each label type. The horizontal line indicates a significant difference in the total number of interactions between label types (**: $P < 0{\cdot}01$).

Table 3. Number of interactions by interaction category for each label type

Interaction category	Label type		
	personal	neutral	threatening
Stolen	4	6	4
Damaged	1	4	6
Opened	0	2	2
Opening attempt	1	7	7
Relocated	4	8	8
Moved	26	32	40

we suppose that well-secured and disguised equipment will be less likely to be stolen or tampered with than our rather conspicuous and completely unsecured experimental dummies. If people interacted with the dummies, it was mostly the *moved* category. It thus appears that people were regularly interested in the dummies and inspected and thereby moved or displaced them, without causing any material damage. However, we could not determine whether *moved* dummies had indeed been moved by humans, or by dogs or other animals sniffing and pushing them. It is thus important to note that the results did not change when we removed the *moved* category from the analyses of the label effect.

EXPERIMENTAL DESIGN AND MULTIPLE EXPOSURES TO THE LABELS

The different label types were equally and regularly distributed over the laid out equipment dummies. Passing people will have randomly noticed one or several dummies and some of them, either on the first or subsequent encounters, might have stopped to read the label. This means that the first label inspected by a person was random. It is likely that park visitors noticed several of the equipment dummies due to the dummies' number and visibility. We thus cannot exclude that some visitors also read multiple, potentially differing, labels. To estimate the likelihood of this behaviour, we observed park visitors during control spot checks of 2·5 h per park. We observed a total of 81 visitors that (i) noticed multiple dummies (head or body turn, pointing), (ii) read the label on one dummy and (iii) did not read the labels on subsequently noticed dummies. In contrast, we observed 10 visitors that noticed and read the label on more than one dummy. Most, yet not all visitors thus read only one label, and our results are likely determined to a large extent by these visitors. As a cautionary note, however, we want to highlight that the effect found here could have been caused by those visitors that had been exposed to multiple messages in an unknown order. As a result of this, visitors could have interacted differently with differently labelled dummies, thus invalidating our results if only the *personal* label is used to protect equipment.

Conclusion

A personal, friendly and appealing label most effectively reduced the overall number of vandalism and theft of unattended scientific field equipment. To our knowledge, this has not been systematically tested before. Note, however, that our findings might only be valid for public spaces similar to the tested ones, that is, public parks in urban, rather wealthy, western areas. It will be important to test whether our results are reproducible under other circumstances, such as parks in other cities with differing social standards and crime rates, or in rural and remote areas (e.g. see Schultz & Tabanico 2009). In the meantime, we propose that, in addition to using standard security measures such as fixing and hiding equipment, researchers label their equipment with personal, appealing and informative messages, which ask the public not to disturb the equipment.

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Author contributions

B-MC, BMS and HRG designed the study; EB, B-MC and HRG collected the data, B-MC analysed the data, B-MC and HRG wrote the manuscript.

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Supporting Information

Additional Supporting Information may be found in the online version of this article.

Table S1. Overview of reported experiences with unattended scientific field equipment, obtained within two weeks after posting a request on two email list servers (ECOLOG-L and EvolDir; 57 reports) and via personal communication with colleagues (four reports).