Moral kinematics: The role of physical factors in moral judgments

Rumen I. Iliev · Sonya Sachdeva · Douglas L. Medin

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Abstract Harmful events often have a strong physical component—for instance, car accidents, plane crashes, fist fights, and military interventions. Yet there has been very little systematic work on the degree to which physical factors influence our moral judgments about harm. Since physical factors are related to our perception of causality, they should also influence our subsequent moral judgments. In three experiments, we tested this prediction, focusing in particular on the roles of motion and contact. In Experiment 1, we used abstract video stimuli and found that intervening on a harmful object was judged as being less bad than intervening directly on the victim, and that setting an object in motion was judged as being worse than redirecting an already moving object. Experiment 2 showed that participants were sensitive not only to the presence or absence of motion and contact, but also to the magnitudes and frequencies associated with these dimensions. Experiment 3 extended the findings from Experiment 1 to verbally presented moral dilemmas. These results suggest that domain-general processes play a larger role in moral cognition than is currently assumed.

Keywords Moral judgments · Causality · Motion · Agency · Physical factors

In this study, we asked a simple empirical question: Do people take physical factors into account when making moral judgments? At first glance, our ability to distinguish good from bad seems more or less independent from the

way that we perceive the physical aspects of our surroundings. Moral principles such as “do no harm” are abstract and largely decontextualized, and many would argue that they have transcendental or sacred aspects embedded in them that go beyond the physical plane. Yet our cognitive system is attuned to the physical aspects of reality (Heider, 1958; Michotte, 1946; Saxe & Carey, 2006; White, 2006, 2009; Wolff, 2008), and we suggest that moral cognition will similarly be sensitive to physical properties. More specifically, we focus on motion and contact, which have been shown to be important factors in judgments of causality and agency, and thus presumably are relevant to attributing moral blame.

The rest of this article is organized as follows: First, we review some relevant findings linking causality to moral judgments; then we briefly describe some of the physical properties that have been associated with causal reasoning; next, we present three empirical studies exploring the roles of motion and contact on moral judgments; and finally, we turn to a discussion on the broader implications of the experimental results.

Causality in moral judgments

Among the different cognitive processes that are relevant to moral judgments, our abilities to perceive meaningful connections between events, to make causal inferences, and to assign causal roles seem particularly important (Baron & Ritov, 2009; Darley & Schultz, 1990; Driver, 2008; Heider, 1958; Lagnado & Channon, 2008; Pizarro, Uhlmann, & Bloom, 2003; Shaver, 1985; Sloman, Fernbach, & Ewing, 2009; Waldmann & Dieterich, 2007). Nevertheless, it is not only the presence or absence of a causal link between actor and outcome that guides our moral judgments. To a large degree, moral judgments hinge on the particular properties

R. I. Iliev (✉) · S. Sachdeva · D. L. Medin
Department of Psychology, Northwestern University,
2029 Sheridan Road, 219 Swift Hall,
Evanston, IL 60208-2710, USA
e-mail: r-iliev@northwestern.edu

of the link. Different actors bringing equivalent harm through different causal paths are often judged differently.

Three causality-based moral factors are particularly important for the present work:

Directness of the harm and locus of intervention Royzman and Baron (2002) made the distinction between direct and indirect harm. Pushing a person who falls as a result is perceived as being worse than pushing a fence on which the person is leaning, causing the person to fall, even though the result is the same. In the first case, the falling of the person is an inherent part of the pushing; in the second, the inherent result concerns the fence, which in turn influences the person (see also Anscombe, 1963, and Davidson, 1980). Recent work by Paharia, Kassam, Greene, and Bazerman (2009) extended these findings to cases of indirect agency, even when the actors and victims were collective entities, such as corporations and the public.

Waldmann and Dieterich (2007) proposed an alternative distinction between victim-based and harm-based interventions. In a series of studies, they found that actors who bring about a negative outcome through harm-based intervention (e.g., throwing a bomb on a person) are blamed less than actors bringing about the same harm through victim-based intervention (e.g., throwing the person on the bomb).

Action–omission Another important causal factor that has been linked to moral judgments is the distinction between action and omission (Ritov & Baron, 1990). An actor who harms a victim through his own action is judged as being worse than an actor who simply fails to prevent the harm. In one scenario, Spranca, Minsk, and Baron (1991) presented participants with a story about a tennis player who intends to eliminate the favorite from the competition by making him eat something that he is allergic to. In the action version, the player orders food that will make the favorite sick, while in the omission case he intentionally does not prevent the competitor from accidentally ordering the same food. The player was judged more harshly in the first than in the second scenario. Similarly, in the case of vaccination, it has been found that people are more reluctant to cause harm through action (vaccinating) than through omission (not vaccinating), even when the odds favor acting (Baron & Ritov, 2004, 2009; Ritov & Baron, 1990).

Personal force Recently, Greene et al. (2009) suggested that another relevant causal factor that influences moral judgments is the amount of personal force involved in the event. For example, harm can be caused entirely by the contractions of the muscle of an actor, or by using other existing forces (see also Unger, 1996, p. 101). Although the authors gave the example of pushing someone off a bridge as harm brought

about through personal force, perhaps a better example (which does not include gravity) would be strangling someone. Contrast this with flipping a switch that redirects an already moving trolley toward a victim on the track. Greene et al. found that the larger the personal force used in producing harm, the larger was the blame assigned to the actor.

The physical aspect of causality and its implications to moral judgments

One feature common to all three factors described above is that they contrast causal structures in which the role of the actor is more salient in one of the interventions than in the other. The clearest example is the action–omission distinction, in which an actor causing harm through action is more easily seen as the cause for the harm, as compared with the same harm brought about through omission, where attention may be directed elsewhere (Spranca et al., 1991; see also Wolff, Barbey, & Hausknecht, 2010). A similar diffusion of causal responsibility is observed in the case of indirect harm: “when harm is indirect, other causes of the harm, aside from a decision maker’s choice, are salient” (Royzman & Baron, 2002). Finally, in the personal force case, the presence of other types of forces reduces the relative causal responsibility of the actor (see also previous work on causal discounting: Kelley, 1972).

Since varying the salience of the agentic role of an actor is important for moral judgments, a relevant question is whether manipulating causal roles in terms of physical causality alone will affect moral judgments. Notice that even though the factors described above have strong physical components, they are still inherently semantic distinctions. Take, for example, the action–omission one, in which we can readily assume that action is inherently associated with more motion or more muscular activity. Although such an assumption will be right in the majority of the cases, the mapping is not necessarily one-to-one. Bennett (1981), for example, pointed to the following exception: a person having to force his body to stay still in order to allow the dust in a room to fall on the ground and close an electric circuit, which, in turn, leads to some outcome. Stillness in this case can be considered as an action, and, as such, it implies a stronger agentic role of the actor, despite the fact that the actor does not generate or transfer a causal quantity.¹ From this perspective, understanding the role of physical factors in moral judgments is closely related, but not equivalent, to previous work on omission bias and directness.

¹ Some will argue that “forcing yourself” to stand still is highly agentic, and Wolff (2008) has suggested cases in which intention is treated similarly to a physical cause, but these parallels are beyond our scope here.

The two physical factors most relevant to our studies are motion and contact. In physicalist approaches to causality, a causal interaction includes an agent-object that possesses some causal quantity and transfers it to a patient-object, ultimately changing its state. A prototypical example is a moving billiard ball hitting a static billiard ball and stopping after the contact, while the second ball starts moving. Here, motion is the causal quantity that is transferred via physical contact from agent to patient. In simple cases like this one, the presence of motion itself is enough for the assignment of an agent or patient role to an object. For example, when participants are asked to describe such an event, they will typically say “One ball set the other one into motion,” but very few will say “One ball stopped the other,” suggesting that they naturally associate motion and agency² (White, 2007).

In order to study the roles of motion and contact on moral judgments, we designed a simple setting that included three interacting objects—the Actor, Victim, and Harm—where the Actor’s behavior led to the Victim contacting the Harm, and subsequently dying. The first hypothesis was that people will be sensitive to motion patterns when assigning blame to an actor. If motion is assigned causal properties, then two predictions follow, one related to the motion of the actor and the other to the motion of the other two objects. The first is that when outcomes are the same, a moving actor will be blamed more than a static actor. This straightforward prediction is closely related to the action–omission distinction and has already been confirmed by other researchers (Spranca et al., 1991). The second prediction is that if there is preexisting motion that is not associated with the Actor, the Actor will be blamed less. For example, if an Actor harms a static Victim by setting him in motion, he will be blamed more than an Actor who redirects an already moving Victim. In other words, when a causal quantity exists independently from the Actor and contributes to the outcome, the Actor’s blameworthiness will be diminished.³

Another hypothesis is that observers will be sensitive to the contact between the Actor and Victim. An Actor intervening directly on the Victim will be blamed more than an Actor who intervenes on the Harm, which then contacts the Victim. This prediction is closely related to the Directness factor (Royzman & Baron, 2002) and to Waldmann and Dieterich’s (2007) locus of intervention, both of which predict that intervention on the victim is worse than intervention on the harm. It also agrees with the results of Cushman, Young, and Hauser (2006) and Cushman and Young (2011), who found that

contact between Actor and Victim affects moral judgments. However, this prediction disagrees with data from Greene et al. (2009), who found that contact between Actor and Victim does not influence moral judgments. We suggest that the pattern that Greene et al. observed may have been due to the way that contact was operationalized in their study: They compared a case in which an Actor pushed a Victim off a bridge using his hands to that of an Actor who used a pole to do the same. In this situation, a pole might not be seen as a mediating object, in the same way as a shoe is not necessarily seen as a causal mediator when a person kicks something. In our experiments, we presented more nuanced tests of the role of contact between Actor and Victim.

A third hypothesis concerns the quantitative aspects of physical factors. Typically, when researchers study the role of different factors on moral judgments, they use binary factors, so that the action either is or is not present, the harm is or is not direct, the causal connection is or is not present, the harm is or is not intended, the outcome is or is not achieved, and so forth. When studying the roles of physical factors, however, it is natural to extend such binary comparisons to quantitative comparisons involving magnitudes and frequencies. Thus, as an extension of the first two hypotheses, we predict that participants will not only be sensitive to the presence or absence of motion and contact, but will also be similarly sensitive to quantitative differences associated with motion and contact.

Overview of the experiments

A series of three experiments were conducted to test the hypotheses outlined above. In Experiment 1, we used video presentations to test the roles of motion and physical contact on the perception of wrongness. For Experiment 2, we used similar stimuli to explore the quantitative aspects of motion and contact, manipulating factors such as Distance, Acceleration, Resistance, and Duration. Experiment 3 is a follow-up study, extending the findings from Experiment 1 to verbal trolley-type scenarios.

Experiment 1

The first experiment provided initial evidence for the roles of motion and contact in moral judgments. In this experiment, we used abstract video stimuli representing dynamic interactions between three objects, resulting in one of the objects being harmed. We evaluated two main hypotheses. The first one dealt with contact and the directness of the intervention.

Hypothesis 1 (H1) Contact between Actor and Victim will lead to harsher moral judgments.

² Notice that this agent–patient distinction is psychological and does not reflect physical interactions in terms of Newtonian mechanics, where the forces applied by the moving and static objects during collision have exactly the same magnitude.

³ Unger (1996) made similar prediction linking “protophysics” to “pseudoethics,” but he did not provide any theoretical justification or empirical testing of his intuitions.

The second hypothesis is related to the origin of causal quantity, which in this particular case is motion:

Hypothesis 2 (H2) Preexisting motion not associated with the Actor will reduce moral blame.

However, since we have two other objects, one on which the Actor intervenes, and one on which the Actor does not, we split this general hypothesis into two, more specific ones:

- H2.1 If the intervened-on object is static, the Actor will be blamed more, as compared to when the intervened on object is moving.
- H2.2 If the non-intervened-on object is static, the Actor will be blamed more, as compared to when the non-intervened-on object is moving.

Method

Participants A group of 22 Northwestern University undergraduate students participated as a partial requirement for an entry-level psychology class.

Stimuli A short movie introduced life on a hypothetical planet, inhabited by *Cylinders* and *Cones*. In addition, there were inanimate objects called *Fireballs*, which were harmless for the Cylinders but deadly for the Cones. The introduction was followed by a presentation of episodes in which the action of a Cylinder resulted in a Cone touching a Fireball, and the subsequent death of the Cone. All video clips were generated in the physics simulator of the Blender software (www.blender.org). For clarity, henceforth we will refer to Cylinders, Cones, and Fireballs as the Actors, Victims, and Harms, respectively.

Design and procedure In the video clips, we manipulated (1) whether the Actor intervened on the Harm, or directly on the Victim; (2) whether the intervention modified the preexisting motion of an object or set a static object into motion; and (3) the dynamic state of the non-intervened-on object, which was also either static or moving. Crossing these three factors resulted in a $2 \times 2 \times 2$ factorial design. One of these conditions is presented in Fig. 1, and the introductory movie with the eight clips can be seen at https://depot.northwestern.edu/xythoswfs/webui/_xy-7745679_1-t_jeReppCo.

First, the participants saw the introduction and all eight clips. After this familiarization phase, the participants were told that they would have to compare the behavior of the Actor in each of the eight clips to the behavior of the Actors in the remaining seven clips, resulting in a total of 28 pairwise comparisons. Then participants saw the two clips from each of the 28 pairs again, and marked their answers on a 6-point scale, ranging from the *The action of the*

Fig. 1 A time sequence of one of the eight video clips used as stimuli in Experiment 1. Here, the Actor (Cylinder) intervenes directly on a moving Victim (Cone), pushing it in the way of a moving Harm (Fireball)

Cylinder in case A was much worse to The action of the Cylinder in case B was much worse. The comparisons were made in two pseudorandom orders. The task was self-paced and took approximately 15 min.

Results and discussion

We dichotomized the data for all 28 comparisons, assigning 1 if the action was judged to be worse in case A and -1 if the action was judged to be worse in case B.⁴ Next, we computed the mean disapproval for each of the eight scenarios. For clarification, if a scenario was always judged to be worse relative to the other seven scenarios, its mean score (M) would be -1; if it was judged to be always better, its

⁴ If we used the original scale as a continuous variable, the results did not change.

mean score would be 1; and if it was judged to be better (or worse) in half of the cases, its mean score would be 0. The mean scores and the corresponding proportions of “worse” choices for the eight events are presented in Table 1. Each of the main effects for the three factors we manipulated was analyzed separately.

To analyze the effect of contact, we looked at the pairs that compared the harm-based interventions to victim-based interventions. Since there were four harm-based intervention videos and four victim-based intervention videos, crossing them resulted in 16 comparisons.⁵ In Table 1, these are the comparisons between Videos 1, 2, 3, and 4 versus 5, 6, 7, and 8. Across these comparisons, in 57 % of the cases the participants judged the victim-based intervention to be worse than the harm-based intervention, which was significantly above chance ($M = .14$, $SD = .21$), $t(21) = 3.43$, $p < .01$.⁶ This result supports our hypothesis that contact between Actor and Victim leads to harsher moral judgments.

The same type of analysis was applied for the role of the dynamic state of the intervened-on object. Out of the eight videos, four involved intervention on a moving object (Videos 1, 2, 5, and 6), and four on a static object (Videos 3, 4, 7, and 8), again resulting in a total of 16 pairwise comparisons. In 59 % of these, the participants judged that an intervention on a static object was worse than an intervention on a moving one ($M = .18$, $SD = .22$), $t(21) = 3.68$, $p < .01$. This finding supports Hypothesis 2.1, that preexisting motion associated with the intervened-on object leads to less harsh moral judgments. Next, we analyzed the role of the dynamic state of the non-intervened-on object. Looking at the 16 comparisons that juxtaposed videos of a moving non-intervened-on object (Videos 1, 3, 5, and 7) to a static non-intervened-on object (Videos 2, 4, 6, and 8), no reliable difference was found ($M = .02$, $SD = .14$), $t(21) = 0.64$, $p > .05$. Thus, Hypothesis 2.2 that a moving non-intervened-on object would reduce blame was not supported.

We also tested whether the effect of one factor depended on the levels of the other factors. The design of the experiment did not allow for the use of a regular ANOVA, because the means for the eight clips were not independent from each other. Instead, we looked to see whether different groupings of these means would reveal any noticeable patterns. There appeared to be an interaction-type mediation related to the role of the non-intervened-on object: When the non-intervened-on object was static, the disapproval for intervening on a static rather than on a moving object was much stronger (i.e., Clips 2 and 6 paired against Clips 4 and 8; $M_1 = -0.39$), as compared to when the non-intervened-on object was moving (Clips 1

Table 1 The design of Experiment 1, in which three binary factors were crossed in a $2 \times 2 \times 2$ design

Clip	Intervened-On Object	State of the Intervened-On Object	State of the NonIntervened-On Object	Mean Disapproval
1	Victim	Moving	Moving	-.08 (54 %)
2	Victim	Moving	Static	.16 (42 %)
3	Victim	Static	Moving	-.24 (62 %)
4	Victim	Static	Static	-.40 (70 %)
5	Harm	Moving	Moving	.18 (41 %)
6	Harm	Moving	Static	.36 (32 %)
7	Harm	Static	Moving	.06 (47 %)
8	Harm	Static	Static	-.04 (52 %)

The last column shows the mean disapproval score, in which more-negative numbers indicate stronger disapproval for the action. The percentages next to the means reflect the proportions of choices in which the given scenario was judged as “worse” than the remaining seven

and 5 vs. 3 and 7; $M_2 = -0.09$). In other words, the effect of the static–moving distinction for the intervened-on object was significantly mitigated when the non-intervened-on object was moving ($\eta_1^2 = .38$ vs. $\eta_2^2 = .04$), $t(21) = 3.70$, $p < .05$.

These results provide some initial evidence that the physical properties of a causal interaction can inform moral judgments in forms not limited to the directness of the intervention. Instead, judgments are also affected by the dynamic states of the participating objects. Nevertheless, it was not simply the presence of motion that played a role. Given that motion can be a cue to agency and causal responsibility, one might expect that any kind of motion not associated with the Actor would mitigate the Actor’s moral responsibility. However, we found that only the motion of the intervened-on object produced a main effect associated with less blame. We speculate that these results may be linked to what Waldmann and Dieterich (2007) labeled *interventional myopia*, in which the information immediately associated with the causal intervention is weighted more heavily than more peripheral information.

Experiment 2

The first experiment revealed that moral judgments are sensitive to the presence or absence of motion of the intervened-on object, and to the presence or absence of contact between Actor and Victim. Taking into account the nature of physical quantities, a follow-up question was whether participants would be similarly sensitive to physical factors when the differences were in magnitudes or frequencies. If motion can be seen as a causal quantity, then “more” motion generated by the actor should lead to harsher moral judgments. Similarly, since contact implies transfer of some

⁵ For clarity, the other 12 pairs compared videos that had the same level of the factor; that is, they juxtaposed harm to harm or victim to victim interventions.

⁶ All statistical tests were two-tailed, unless otherwise stated.

causal quantity, “more” contact between Actor and Victim should suggest a stronger causal connection, again leading to harsher moral judgments. Thus our general prediction is:

Hypothesis 3 (H3) Higher magnitudes and frequencies associated with motion and contact will lead to harsher moral judgments.

This hypothesis can be further divided into five more-detailed predictions:

- H3.1 *Magnitude of force*: Larger force used by the Actor should lead to harsher judgments. Larger force can be indicated by more acceleration or by the presence of an obstacle or source of resistance (such as the slope of the surface).
- H3.2 *Physical contact*: Outcomes that include physical contact will lead to harsher judgments.
- H3.3 *Distance traveled by the Actor before the contact*: Longer distances traveled are predicted to lead to harsher judgments. Here motion (or work) is used as an indicator of the causal quantity generated by the Actor, so a longer distance traveled would be associated with more motion, and thus larger causal quantity.
- H3.4 *Duration of the contact between Actor and Victim*: Longer durations of contact are predicted to lead to harsher judgments. The rationale for this prediction is twofold. First, if participants are sensitive both to physical contact and to the magnitudes of physical factors, they should be sensitive to the duration of physical contact. Second, longer physical contact may imply more resistance encountered, and thus larger force applied.
- H3.5 *Frequency of contacts*: A greater number of contacts should be associated with harsher judgments. The rationale is the same as in the last prediction. Alternatively, if contact is treated as the “boundary” of an act, more contacts can be also interpreted as more acts, leading to the same prediction.

Given that we are exploring a much broader set of physical factors, the present experiment does not follow the factorial design of the previous one, but rather relies on paired comparisons that differ on a single factor (whenever possible) to examine this broader range of physical characteristics.

Method

Participants A group of 16 Northwestern University undergraduate students participated for course credit.

Design and procedure The participants saw the same introductory movie shown in Experiment 1. After the introduction,

they saw 15 pairs⁷ of video clips in which the behavior of the Actor led to the death of the Victim. Most pairs differed on a single factor. For example, in the first video clip in Comparison 1, the participants saw an Actor who traveled a short distance before pushing the Victim, while in the second video clip in the same comparison, the Actor traveled a longer distance. Comparison 6 juxtaposed an Actor who traveled on a flat surface with one who traveled uphill. The 15 comparisons and the factors manipulated are represented in Table 2, and the actual stimuli can be seen at https://depot.northwestern.edu/xythoswfs/webui/_xy-7745556_1-t_m0AgbcWl. After seeing each comparison, the participants were asked to judge in which case the behavior of the Actor was worse, using the same 6-point scale as in Experiment 1. The comparisons were presented in four pseudorandom orders.

Results and discussion

For each pair, the choices predicted from a physicalist framework were coded as 1, while the alternative choices were coded as 0. First we looked at the overall effect of physical factors. Collapsing across all 15 comparisons, 80 % of the choices were in the predicted direction, which was significantly higher than chance [$t(14) = 8.89, p < .01$]. We interpreted this as showing overall support for Hypothesis 3. Next, we looked at each comparison separately. Twelve of the comparisons achieved statistical significance according to a sign test, two were not statistically reliable but were in the predicted direction (67 % and 69 % of the cases), and one comparison showed no trend (50 %). The means for each comparison are reported in Table 2.

Now we will consider each of the predictions separately. The magnitude of force (H3.1) was varied in Comparisons 3, 4, 5, 6, 7, and 8. Averaging across these probes, in 76 % of the cases, participants judged the Actor using greater force as worse [$t(15) = 5.72, p < .01$]. Physical contact between Actor and Victim (H3.2) was varied in Comparisons 10 and 11, and in 72 % of the cases the participants judged contact to be worse [$t(15) = 2.41, p < .05$]. The distance traveled by the Actor (H3.3) was varied in Comparisons 1, 2, 3, and 8, and in 86 % of the cases the participants judged the longer distance to be worse [$t(15) = 7.91, p < .01$]. Analyzing duration of contact (H3.4) in Comparisons 13, 14, and 15 revealed that, for 92 % of the answers, longer duration led to harsher judgments [$t(15) = 11.19, p < .01$]. Finally, number of contacts (H3.5) was varied only in Comparison 12, and 75 % of the participants judged two contacts to be worse than one ($p < .05$, one-tailed sign test). In summary, all five of the predictions were supported by the data.

⁷ Another four pairs were also presented, but they are not of interest for the present work.

Table 2 Summary of the comparisons in Experiment 2

	Factor	Implementation	Clip A (predicted “worse”)	Clip B	Agreement
MORAL KINEMATICS					
1	Distance	Long distance versus short distance travelled by the Cylinder before the contact			0.82*
2	Distance	Long distance versus medium distance travelled by the Cylinder before the contact			0.88*
3	Force/Distance	Cylinder is moving versus static, physical contact in both cases			0.75*
4	Force	Cylinder moves the Cone downhill versus on a flat surface			0.5
5	Force	Cylinder moves the Cone downhill versus uphill			0.67
6	Force	Cylinder moves the Cone uphill versus on a flat surface			0.84*
7	Force	Cone travels faster versus slower after the contact			0.75*
8	Force/Distance	Cylinder is moving versus staying static. In both cases the Cone hits the Fireball without the Cylinder touching either of them.			1*
9**	Force vs Contact	Cylinder is static and the Cone bounces into it (physical contact) versus the Cylinder moves out of the way of the Cone (no physical contact)			0.82*
10	Contact	A static Cylinder is either contacted or not by a Cone			0.75*
11	Contact	Moving Cylinder contacts vs does not contact a Cone			0.69
12	Frequency	Two contacts versus one contact			0.75*
13	Duration	Cylinder pushes versus touches the Cone			1*
14	Duration	Cylinder pushes the Cone for a long versus medium period of time			0.82*
15	Duration	Cylinder pushes the Cone for a long versus short period of time			0.94*

The graphical representations indicate the motion patterns of the participating objects, juxtaposing the two clips in each pair. In the “Clip A” column are the events that a physicalist framework predicts would be judged as being “worse” than the ones in the “Clip B” column. In all events, the final outcome was a contact between the Harm and the Victim. The numbers in the rightmost column, labeled “Agreement,” indicate the proportions of participants making choices consistent with a physicalist framework. Notice that if participants were choosing randomly, the proportion would be .50, while if they were consistently choosing the opposite answer, the agreement with a physicalist framework would be less than .50. The given mean is different from chance (.50) at $p < .05$. Comparison 9 involves two opposing physical factors, in which the directionality of the comparison favors motion over physical contact

Although this experiment was mainly designed to explore the roles of separate physical properties rather than to estimate the relative importance of different factors by juxtaposing them, one scenario directly compared the relative roles of two factors. Comparison 9 presented one clip in which an Actor moved away from the oncoming Victim, resulting in the Victim crashing into the Harm, and a second clip in which a Victim bounced off a static Actor, going into the Harm. If participants are more sensitive to physical contact than they are to motion, they should judge the second Actor to be worse than the first one, since in the first case there was no physical contact. If, on the other hand, motion is more important than physical contact, the opposite pattern would be expected, and indeed, that is what we observed. Of the participants, 81 % judged the motion without contact to be worse than no motion with contact ($p < .05$, sign test). This finding suggests that physical contact is only a way to trace physical quantities rather than a major indicator of moral responsibility. In this case, when no physical energy originated from the actor, the role of physical contact was diminished. Nevertheless, physical contact was taken into account even in the absence of any movement on the part of the actor. In Comparison 10, a static Actor was either contacted or not contacted by a moving Victim. In this case, when no motion was present, 75 % of the participants judged contact to be worse than no contact ($p < .05$, one-tailed sign test). This pattern suggests that both motion and contact are taken into account, but when they conflict, motion may be taken as the more important cue. Of course, motion and contact are not categorical variables, and the relative importances of the two likely depend on how strongly they are manipulated.

This study provides further support for the hypothesis that physical factors are consistently used as a basis for forming moral judgments. They also demonstrate that the difference in factors does not have to be qualitative or categorical, but can be quantitative, based on magnitudes and frequencies. Whenever the Actor traveled farther or faster, pushed the Victim for a longer distance, or overcame obstacles such as gravity and resistance, participants judged the action to be worse.

Experiment 3

The first experiment demonstrated that when motion and contact are presented visually, observers use them as cues to inform their moral judgments. These findings, however, may be limited to abstract visual presentations and to events in which harm is the only outcome. The present experiment was designed to test whether the roles of motion and contact can be generalized further to less abstract scenarios. Relative

to Experiment 1, there were two important changes in the new experiment: First, we presented information in verbal form describing humans in real-life situations; second, we employed a dilemma structure, in which the intervention of the actor brought about both a positive and a negative outcome.

The scenarios were variations of the trolley problem, in which the Actor intervenes either on the Victim or on the oncoming Harm. Notice that in the original version of the problem, flipping the switch is also an intervention on a moving object, whereas in the footbridge case, the intervention is on a static object, so part of the asymmetry in our intuitions might be due to the dynamic state of the intervened-on object. To test this hypothesis, in the present experiment we manipulated the dynamic state of the Victim, expecting that intervention on a moving Victim would be judged less harshly than intervention on a static Victim (H2.1). From the results of Experiment 1, we did not expect the dynamic state of the Victim to play a role when the intervention was on the Harm (H2.2). Finally, we also expected to replicate H1, finding again that an intervention on the Victim was judged to be worse than an intervention on the Harm.

Method

Participants A group of 120 Northwestern University undergraduate students participated in the experiment as partial fulfillment for a class requirement.

Stimuli Four different situations described a person in a position of responsibility who was in a trolley-type moral dilemma, in which the only way to save five of his subordinates was to sacrifice one of them. The four actors were an army officer, a zoo manager, a railway station manager, and a biohazard lab manager. Each scenario had four different versions, wherein two factors were manipulated: The first was whether the Actor intervenes on a Harm or on a Victim, and the second, whether the dynamic state of the Victim was moving or static. The scenarios are given in the [Appendix](#).

Design and procedure Each participant received four scenarios in total, one of each content type (army, zoo, train, and biohazard) and one of each of the four experimental conditions (harm intervention–static victim, harm intervention–moving victim, victim intervention–static victim, and victim intervention–moving victim). After the participants had read the scenarios, they were asked to go back and draw a schematic representation to help them visualize each of the four situations. After finishing the drawings, the participants were asked to compare the decision in each of the scenarios to the decisions in the other three, resulting in six total

pairwise comparisons. Participants indicated their answers on the same 6-point scale used in Experiments 1 and 2. The comparisons were made in eight different pseudorandom orders. Note that this design allowed us to assess both the dynamic factors manipulated and the effects of content domain.

Results and discussion

As in Experiment 1, the scenario that was judged as being better in each pairwise comparison received a score of 1, while the one judged as being worse received a score of -1; that is, an average score of 0 meant that a scenario was judged to be better in half of the cases. The mean scores for each comparison are presented in Table 3. First, we tested whether intervention on the Victim was judged as being worse than intervention on the Harm. In Table 3, this is a comparison of Scenarios 3 and 4 versus Scenarios 1 and 2. Collapsing across different contexts, decisions that involved a direct intervention on the Victim were judged as being more inappropriate than the decisions that intervened on the Harm [$M = -.22$; $t(119) = 6.08$, $p < .05$]. Next, we tested the general version of Hypothesis 2, the prediction that preexisting motion in general, regardless of whether it is associated with the intervened-on or the non-intervened-on object, will lead to less harsh moral judgments. This is the comparison between Scenarios 1 and 3 and Scenarios 2 and 4 in Table 3. There was no statistically reliable effect of the overall moving/static Victim distinction [$M = -.06$; $t(119) = 1.69$, $p > .05$]. However, looking only at the moving/static comparison when the intervention was directly on the Victim (i.e., comparing Scenarios 3 and 4) showed a reliable effect: Sixty-one percent of the participants judged the intervention on a static Victim to be worse than the intervention on a moving Victim [$M = -.22$; $t(119) = 2.42$, $p < .05$]. The moving/static Victim distinction did not seem to play a role when the intervention was on the Harm [$M = 0$; $t(119) = 0$, $p > .05$]. In other words, as in Experiment 1, H2.1 was supported, while H2.2 was not.⁸

In addition to the effects of the physical factors, there were also strong content effects. For example, intervention by an army officer was judged as being less bad in 86 % of all comparisons of which it was a part, regardless the particular causal structure that the scenario described [$M = -.72$; $t(119) = 14.47$, $p < .05$]. In fact, when the army scenario was part of the classical “switch-footbridge” comparison (with both victims being static), we did not even observe the typical trolley effect [$t(35) = 1.35$, $p = .19$], which shows that participants were more influenced by content than by the victim–harm or static–moving distinctions. The content effects that

we observed here are important but not surprising. Moral norms and expectations are often dependent on the particular social roles involved, regardless of the abstract causal structure of the situation. Haidt and Baron (1996), for example, found that the effect of the action–omission distinction is dependent on the particular social role of the hypothetical Actor. Going back to our scenarios, an army officer sacrificing soldiers is less unexpected than a lab manager sacrificing research assistants.

Overall, the results replicate those from Experiment 1, in which both the directness of the intervention (H1) and the dynamic state of the intervened-on object (H2.1) matter. The present experiment also showed that the effects of motion were not limited to seeing moving objects, but were also present when motion was just mentioned in a scenario. And finally, these effects of causal path were accompanied by strong content effects related to the social role of the Actor.

General discussion

The ways in which we understand the social and the physical worlds are very different (Anderson, 1972), and we become sensitive to this difference very early on in our development (Leslie, 1994; Wynn, 2008). Yet the physical aspects of cognition are not limited to understanding simple interactions between inanimate objects, but instead influence how we process a much broader set of information, including events from the social world (see diSessa, 2000). In the present experiments, we demonstrated that physical quantities also influence our moral judgments. In Experiment 1, we used video clips with a minimal context, varying the directness of the intervention and the dynamic state of the participating objects. In agreement with a number of previous findings, intervening directly on the victim was judged as being worse than intervention on the harm. In addition, intervention on a moving object was judged as being less bad than intervention on a static object. Experiment 2 explored a broader range of physical factors, again finding a pattern consistent with a physicalist framework. For example, participants in this experiment were sensitive both to the properties of the physical contact between Actor and Victim and to the amount of energy that the Actor expended. Experiment 3 extended these findings to verbal presentations and to bivalent outcomes that combined positive and negative consequences.

The finding that the dynamic states of the objects and the physical properties of the contact influence subsequent moral judgments has two important implications. On a general level, it is directly related to the affect–cognition debate in the field (Haidt, 2007, 2010; Narvaez, 2010), emphasizing the importance of understanding the cognitive processes involved in moral judgments. A common criticism to affect-based

⁸ We also analyzed the schematic representations that the participants drew after reading the scenarios, but we did not find any patterns reflecting the experimental manipulation or the participants' subsequent judgments.

Table 3 A summary of the six pairwise comparisons in Experiment 3

Scenario		1	2	3	4
Harm Intervention	Moving victim	1	.	0 (50 %)	.22 (39 %)*
	Static victim	2	0 (50 %)	.	.32 (34 %)*
Victim Intervention	Moving victim	3	-.22 (61 %)*	-.32 (66 %)*	.
	Static victim	4	-.46 (73 %)*	-.36 (68 %)*	-.22 (61 %)*

Each cell shows the mean disapproval score for the scenarios in the rows as compared to the scenarios in the columns, in which more-negative scores indicate higher disapproval. For clarity, this number is also converted into a percentage that shows how often the scenario in the row was judged as being worse than the scenario in the column. The asterisks indicate that the preference was statistically different from chance at $p < .05$

approaches is that they cannot make ad-hoc predictions about the particular properties of the information that leads to stronger affective response. From this perspective, theories that focus on the cognitive processes involved in moral judgments will be a necessary part of any broader theory about morality (see Clore & Ortony, 2000, 2008, on cognition and emotion).

Furthermore, our results suggest a much larger role for domain-general causal principles than is currently accepted in the field of moral cognition (for a discussion, see Haidt & Joseph, 2007). For example, Hauser (2006a, 2006b) and Mikhail (2007, 2009) have argued that, similar to language, domain-specific rules that are part of a universal⁹ moral grammar are the primary determinants of our moral reasoning. Among these rules, for instance, is the *doctrine of double effect*, which, on one of its readings, allows harm to happen as a side effect of an otherwise good action, but not as a means for achieving a better end. A pro-life doctor might perform a life-saving surgery on a pregnant woman that would result in the death of the fetus, but would not abort the fetus even if this would save the mother's life, too. Notice that this rule is actually a detailed analysis of the causal structure of the action, but unlike the other causal principles discussed here, it is focused solely on morally relevant situations, in which both positive and negative outcomes result from the same intervention, and in which a situation can be parsed into means, ends, and side effects. Although the experiments presented here were not designed as a direct argument against domain-specific causal principles in morality, the results demonstrate a surprising role of domain-general causal factors (see also Rai & Holyoak, 2010). When combined with previous findings on action–omission, the roles of directness and physical contact, and personal force, our results suggest a large and consistent role of causal inferences in moral judgments (for a recent discussion on the domain specificity and domain generality of moral principles, see Young & Dungan, 2012).

⁹ For empirical tests of cultural universality, see Hauser, Cushman, Young, Jin, and Mikhail (2007) and Banerjee, Hübner, and Hauser (2011).

Before closing, we need to address two limitations of the present work. The first is related to the role of mental states in moral judgments. Here, we have established connections between physical factors and morality, but we have not explored in depth the specific mechanisms behind this link. We know that patterns of physical motion are not only linked to the transfer of causal quantities, but can also imply animacy, agency, intentionality (Gao, Newman, & Scholl, 2009; Scholl & Tremoulet, 2000), or even emotional states and social relations (Barrett, Todd, Miller, & Blythe, 2005; Bloom & Veres, 1999; Heider & Simmel, 1944). From this perspective, one possibility is that physical factors are used only as cues to infer mental states, which subsequently are used to form moral judgments. A full answer to this question is beyond the scope of this article, yet we believe that inferred differences in mental states will not be enough to explain our main findings. For example, in Experiment 3 we explicitly described the intentions of the Actor, yet judgments were still sensitive both to contact and to the dynamic state of the intervened-on object. Further support for the idea that the role of causal cues goes beyond inferences about mental states comes from previous work on omission bias by Spranca et al. (1991). They found that although the properties of the causal path between Actor and Victim often imply different intentionality, controlling for intentionality does not eliminate the link between the causal path and moral judgments.

Also, we have largely ignored the role of the normality or surprisingness associated with an action, which has been proposed as another major factor for causal inferences (Hart & Honoré, 1985; Hilton & Slugoski, 1986; Kahneman & Miller, 1986; Kelley, 1972). For instance, witnessing a hammer hitting the crystal of a wristwatch, which breaks as a result, easily implies an agentic causal role for the hammer. When presented with the additional information that the event takes place in a testing facility in a wristwatch factory, however, we no longer see the hammer as the main cause, but rather attribute the outcome to the weakness of the crystal (Einhorn & Hogarth, 1986). In the second case, the physical cues to causality are overshadowed by the knowledge activated when thinking about the testbed context. The strong content effects observed

in Experiment 2 further illustrate the roles of expectations and norms when distinguishing between otherwise causally similar events.

Conclusion

One needs to keep in mind that moral cognition is not simpler than cognition itself. Hauser (2006b) pointed out that one of the central questions that moral psychology faces is to discover how the moral mind is different from, and how it is similar to, the nonmoral mind: “we not only wish to uncover those processes that clearly support our moral judgments, but in addition, identify principles or mechanisms that are selectively involved in generating moral judgments.” In this article, we have demonstrated one surprising way in which moral cognition is similar to rather than different from nonmoral cognition. We take these results as a demonstration that cognitive theories of domain-general causality can be a useful tool when charting the boundaries of the moral mind.

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Appendix: Scenarios used in Experiment 2

Each participant saw four scenarios, one of each content type (army, zoo, train, and biohazard) and one of each of the four causal structures (harm intervention–static victim, victim intervention–static victim, harm intervention–moving victim, victim intervention–moving victim).

Instructions

In this experiment you will be presented with 4 hypothetical cases, where a person in charge had to make life and death decision. In each situation the lives of 5 people were endangered and the only way to save them was to sacrifice the life of another person. Assume that there were no other possible solutions. In all 4 cases the person in charge made the decision to sacrifice one life and save the other 5, but the cases differ in many ways. After getting familiar with each of the 4 cases, we will ask you to compare each situation to each other situation, indicating in which case the action chosen by the decision maker was worse (or less appropriate). In some scenarios it might be difficult to make the comparison, but in any case try

to make the choice and tell us which action looks worse to YOU. Finally, treat each pair of comparisons independently of the other scenarios.

Army

Army/harm intervention/static victim

During a military operation behind enemy lines a dangerous situation emerges. A superior enemy force is moving down the road toward the camp of 5 Marines, who will be surprised and inevitably killed. The officer in charge at the Pentagon does not have radio connection with anyone on the ground, but he can order a bomb strike which would force the enemy to take another route. This will give the rescue teams enough time to save the 5. However, a single Marine is stationed on the alternative route so if the enemy troops go in that direction they will inevitably spot and kill the single soldier. The officer orders the air strike, which leads to saving the five soldiers, but also to the death of the single one.

Army/victim intervention/static victim

During a military operation behind enemy lines a dangerous situation emerges. A superior enemy force is moving down the road toward the camp of 5 Marines, who will be surprised and inevitably killed. The officer in charge at the Pentagon does not have radio connection with the 5, but he can communicate with another Marine who is positioned not far from the road. The only way to save the 5 is if the single soldier quickly moves down to the road and opens fire. This will alert the 5 and give them enough time to run to safety, but will inevitably lead to his death. The officer orders the single soldier to walk down to the road and open fire, which leads to saving the five soldiers, but also to the death of the single one.

Army/harm intervention/moving victim

During a military operation behind enemy lines a dangerous situation emerges. A superior enemy force is moving down the road toward the camp of 5 Marines, who will be surprised and inevitably killed. The officer in charge at the Pentagon does not have radio connection with anyone on the ground, but he can order a bomb strike which will force the enemy to take another route. This will give the rescue teams enough time to save the 5. However, near by the road a single Marine is walking toward a different objective. If the enemy troops take the alternative route, they will inevitably spot and kill the single soldier. The officer orders the air strike, which leads to saving the five soldiers, but also to the death of the single one.

Army/victim intervention/moving victim

During a military operation behind enemy lines a dangerous situation emerges. A superior enemy force is moving down the road toward the camp of 5 Marines, who will be surprised and inevitably killed. The officer in charge at the Pentagon does not have radio connection with the 5, but he can communicate with another Marine who is nearby, walking toward a different objective. The only way to save the 5 is if the single soldier changes his direction and opens fire at the enemy. This will alert the 5 and give them enough time to run to safety, but will inevitably lead to the death of the single soldier. The officer orders the single soldier to change his direction and to open fire, which leads to saving the five soldiers, but also to the death of the single one.

Zoo

Zoo/harm intervention/static victim

During lunch hours in a large zoo an accident is on its way. A raging bull elephant breaks through one of the fences and goes on a killing rampage. He runs toward a small cottage where 5 zoo-keepers are having lunch. The 5 are unaware of the danger, so they will be surprised and trampled to death. The zoo manager watches the event on the surveillance cameras and looks for a way to save the five. He doesn't have any way to warn them, but from his office he can start a fire alarm so that the fire-extinguishers will make the running elephant change his direction and enter a different fenced area. Unfortunately, in this area another zoo-keeper is having his lunch and will inevitably be trampled to death. The zoo manager starts the fire alarm, which leads to the saving of the five zoo-keepers, but also to the death of the single one.

Zoo/victim intervention/static victim

During lunch hours in a large zoo an accident is on its way. A raging bull elephant breaks through one of the fences and goes on a killing rampage. He runs toward a small cottage where 5 zoo-keepers are having lunch. The 5 are unaware of the danger, so they will be surprised and trampled to death. The zoo manager watches the event on the surveillance cameras and looks for a way to save the five. He doesn't have any way to warn them, but he can still communicate with a single zoo-keeper who is having his lunch not far from the barn. The only way to save the five is if the single zoo-keeper runs in the elephant's way and gets the animal's attention, which unfortunately will lead to him being trampled to death. The zoo manager orders the single zookeeper to approach the elephant, which leads to the saving of the five zoo-keepers, but also to the death of the single one.

Zoo/harm intervention/moving victim

During lunch hours in a large zoo an accident is on its way. A raging bull elephant breaks through one of the fences and goes on a killing rampage. He runs toward a small cottage where 5 zoo-keepers are having lunch. The 5 are unaware of the danger, so they will be surprised and trampled to death. The zoo manager watches the event on the surveillance cameras and looks for a way to save the five. He doesn't have any way to warn them, but from his office he can start a fire alarm so that the fire-extinguishers will make the running elephant change his direction and enter a different fenced area. Unfortunately, another worker driving a small utility vehicle is heading toward this area, too, so he will inevitably be trampled to death. The zoo manager starts the fire alarm, which leads to the saving of the five zoo-keepers, but also to the death of the single one.

Zoo/victim intervention/moving victim

During lunch hours in a large zoo an accident is on its way. A raging bull elephant breaks through one of the fences and goes on a killing rampage. He runs toward a small cottage where 5 zoo-keepers are having lunch. The 5 are unaware of the danger, so they will be surprised and trampled to death. The zoo manager watches the event on the surveillance cameras and looks for a way to save the five. He doesn't have any way to warn them, but he still can communicate with a single zoo-keeper who is driving a small utility vehicle toward the neighboring rhino barn. The manager could order the single worker to swerve toward the elephant barn instead of continuing toward the rhino, in which case the elephant will attack the vehicle and trample the worker to death, but the 5 will be saved. The manager orders the single zoo-keeper to change his path, which leads to the saving of the five zoo-keepers, but also to the death of the single one.

Train

Train/harm intervention/static victim

During construction work on a major train station a disaster is on its way. A gas-tank train car is running toward a small trolley parked on the tracks. If the train car hits the trolley, the resulting explosion will kill all 5 people who are sitting in the trolley. The station manager sees what is going to happen and looks for a way to save the five. He realizes that the only way to save them is if he flips a switch on his dashboard, which will redirect the oncoming gas-tank onto another track. Unfortunately, on this second track there is another trolley with a single person, who will die if the trolley is hit by the train car. The manager redirects the gas-tank, which results in saving the five people, but also in killing the single one.

Train/victim intervention/static victim

During construction work on a major train station a disaster is on its way. A gas-tank train car is running toward a small trolley parked on the tracks. If the train car hits the trolley, the resulting explosion will kill all 5 people who are sitting in the trolley. The station manager sees what is going to happen and looks for a way to save the five. There is another trolley car with a single person in it, parked on an adjacent track. The manager realizes that the only way to save the 5 is to throw a switch on his dashboard, which will start the engine of the single-person trolley and move it on the first track, where it will collide with the oncoming gas-tank. Unfortunately the resulting collision will kill the person in the trolley. The manager moves the second trolley, which results in saving the five people, but also in killing the single one.

Train/harm intervention/moving victim

During construction work on a major train station a disaster is on its way. A gas-tank train car is running toward a small trolley parked on the tracks. If the train car hits the trolley, the resulting explosion will kill all 5 people who are sitting in the trolley. The station manager sees what is going to happen and looks for a way to save the five. He realizes that the only way to save them is if he flips a switch on his dashboard, which will redirect the oncoming gas-tank onto another track. Unfortunately, on this second track there is another trolley with a single person in it, who will die if the trolley collides with the gas tank. The manager redirects the gas-tank, which results in saving the five people, but also in killing the single one.

Train/victim intervention/moving victim

During construction work on a major train station a disaster is on its way. A gas-tank train car is running toward a small trolley parked on the tracks. If the train car hits the trolley, the resulting explosion will kill all 5 people who are sitting in the trolley. The station manager sees what is going to happen and looks for a way to save the five. There is another trolley car with a single person in it, running on an adjacent track. The manager realizes that the only way to save the 5 is to throw a switch on his dashboard, which will redirect the single-person trolley toward the first track where it will collide with the oncoming gas-tank. Unfortunately the resulting collision will kill the person in the trolley. The manager redirects the second trolley, which results in saving the five people, but also in killing the single one.

Biohazard**Biohazard/harm intervention/static victim**

In a bio-research facility deadly fumes escape from a container in one of the labs. The research facility manager detects the problem and tracks the path of the fumes on his monitoring system. Very soon the fumes will enter the ventilation system and from there they will go to a room with five research assistants taking a nap before their night shift. The five cannot be warned about the coming threat, so if the fumes enter their room all will die. The manager can close a vent which will change the air circulation path and the fumes will enter another room where one research assistant is resting before the night shift. The manager closes the vent, which results in saving the five researchers, but also in killing the single one.

Biohazard/victim intervention/static victim

In a bio-research facility deadly fumes escape from a container in one of the labs. The research facility manager detects the problem and tracks the path of the fumes on his monitoring system. Very soon the fumes will enter the ventilation system and from there they will go to a room with five research assistants taking a nap before their night shift. The five cannot be alerted to the coming threat, so if the fumes enter their room all will die. The manager still has contact with another research assistant who is having a rest before the night shift in another room. The room where the research assistant is staying is too far from the five, so he cannot signal them, but he has time to go to the lab and close the container before the fumes reach the ventilation system. Unfortunately if he enters the lab with the container he will die shortly after. The manager orders the single research assistant to go to the lab and close the container, which results in saving the five researchers, but also in killing the single one.

Biohazard/harm intervention/moving victim

In a bio-research facility deadly fumes escape from a container in one of the labs. The research facility manager detects the problem and tracks the path of the fumes on his monitoring system. Very soon the fumes will enter the ventilation system and from there they will go to a room with five research assistants taking a nap before their night shift. The five cannot be alerted to the coming threat, so if the fumes enter their room all will die. The manager can close a vent which will change the air circulation path and the fumes will go out from the lab into an adjacent corridor and soon will disperse below the dangerous level. Unfortunately, a single research assistant is walking through the corridor in close proximity to the lab and if the fumes enter the corridor he will die. The manager closes

the vent, which results in saving the five researchers, but also in killing the single one.

Biohazard/victim intervention/moving victim

In a bio-research facility deadly fumes escape from a container in one of the labs. The research facility manager detects the problem and tracks the path of the fumes on his monitoring system. Very soon the fumes will enter the ventilation system and from there they will go to a room with five research assistants taking a nap before their night shift. The five cannot be alerted to the coming threat, so if the fumes enter their room all will die. A single research assistant is walking through the corridor in close proximity to the lab, and although he cannot warn the five about the coming threat, he can enter the lab and close the container before the fumes enter the ventilation system. Unfortunately if he enters the lab with the container he will die shortly after. The manager orders the single research assistant to change his path, enter the lab, and close the container, which results in saving the five researchers, but also in killing the single one.

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