Motiv Emot
DOI 10.1007/s11031-013-9353-6

ORIGINAL PAPER

Introducing the sick face

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Abstract Research on disgust in neuroscience, medicine, and psychology often relies on a disgust facial expression from a standardized set. Two studies (N = 60 and N = 160) compared this standard disgust face to a new facial expression called the "sick face" posed by three different actors asked to look as if they were sick and about to vomit. Relative to the standard disgust face, the sick face was significantly more likely to be endorsed as disgust, less likely to be endorsed as another emotion, and rated as conveying disgust more intensely. Disgust may not have a facial signal, but various faces may serve as cues to disgust.

Keywords Disgust · Emotion · Facial expression

Introduction

Disgust has been theorized to be one of a small number of basic emotions (Ekman and Friesen 1976; Izard 1992; Johnson-Laird and Oatley 1989; Rozin et al. 2008), indeed the most visceral of them (Harrison et al. 2010), and perhaps the most ancient (Williamson and Allman 2011). Disgust's role in avoiding poisons and infections provides clear survival value and underpins the theory of its evolutionary origins (Ekman and O'Sullivan 1991; Lazarus 1991). Much theorizing and research on disgust has relied on the notion that it is signaled by a specific facial expression, universally produced and universally recognized. The topic of the present study is the facial expression of disgust offered in standardized sets of facial expressions and a comparison of that expression to an expression we call the sick face.

Darwin (1965) speculated that human facial expressions arose not for their use in communication, but primarily as "serviceable associated habits… (which) may not then be of the least use" (p. 28). Regarding the facial expression of disgust, he wrote, "Extreme disgust is expressed by movements round the mouth identical with those preparatory to the act of vomiting" (p. 257). In contrast, some theorists after Darwin suggested that human facial expressions did indeed evolve for the purpose of communication (Tomkins and McCarter 1964). This idea is now often stated by calling a facial expression a "signal"—defined by Maynard Smith and Harper (2003) as "any act or structure which alters the behavior of other organisms, which evolved because of that effect, and which is effective because the receiver's response has also evolved" (p.3). Thus, only some facial movements are signals; others are cues. In modern theories of basic emotions, calling a facial expression of disgust a signal implies recognition of disgust from that facial expression. Izard (1994) emphasized the adaptive value of the disgust signal conveying disgust and only disgust rather than any other emotion. There is no evolutionary advantage in producing unrecognized signals (Fridlund 1994). If a facial expression is a signal, then recognition of that facial expression had to coevolve with production of that facial expression if they were to evolve at all.

Early work on basic emotions sought to identify the universal signal for each basic emotion (Tomkins and McCarter 1964; Izard 1971; Ekman et al. 1969). Ekman and Friesen (1978) subsequently used their facial action

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Published online: 06 April 2013

Fig. 1 An example of the standard disgust face (left, AUs 9 +10) and the sick face (right, AUs 6 + 7 + 10 + 26)

coding system (FACS) to specify that the expression of disgust must at a minimum consist of one or both of two action units (AUs), AU 9 (nose wrinkle) and AU 10 (upper lip raise). The prototype of the disgust expression combines these two AUs, as shown in the left panel of Fig. 1. Based on this work, standard sets of facial expressions of basic emotions all include a disgust expression with one or both of these AUs: Pictures of Facial Affect (Ekman and Friesen 1976), NimStim Face Stimulus Set (Tottenham et al. 2009), and Amsterdam Dynamic Facial Expression Set (van der Schalk et al. 2011). This standard disgust face has been used in measures of emotional intelligence (Mayer et al. 1990), in diagnostic tools for disorders including phobias, anxiety disorders, and Huntington's disease (Olatunji and McKay 2007; Phillips et al. 1998, Sprengelmeyer et al. 1996), in neuroscientific studies mapping brain circuits specific to disgust (Phillips et al. 1997), and in developmental studies on the role of facial expressions in children's understanding of others' emotions (see Widen 2013) and desires (Repacholi and Gopnik 1997).

Available evidence raises questions about the association of disgust with the standard disgust face, both in terms of production (see the review by Reisenzein et al. 2013) and recognition. Regarding recognition, which is the focus of the present study, available evidence questions whether the standard disgust face signals disgust universally. In early studies of illiterate cultures relatively isolated from the West, observers were asked to freely label the standard disgust face. The most common label from one sample was *contempt* and from the two other samples was *happiness* (Sorenson 1976). When observers from the same illiterate cultures were asked to select one emotion from a short list for each of the hypothesized facial expressions of basic emotions, results for the standard disgust face were weaker than for other faces: The percentage who selected *disgust* for the standard disgust face ranged from <23 % to 44 % in three samples (see the review by Russell 1994). With the same response format, cross-cultural studies of less isolated populations found the standard disgust face was "recognized" less frequently than the facial expressions of other emotions (see the review by Nelson and Russell 2013).

Other evidence showed that the standard disgust face may express emotions other than disgust: When observers were asked to select the person who felt angry from an array of faces, both Canadians and Americans chose the standard disgust face as often as the anger face (Bullock and Russell 1984; Widen and Russell 2008). In short, the standard disgust face is surprisingly weakly associated with disgust and surprisingly strongly associated with anger.

Rozin et al. (1994) offered an important theoretical analysis and supporting data showing that the category of disgust includes a variety of reactions to a variety of elicitors and is manifest in a variety of facial configurations. Various facial expressions are associated with separate functional values, and observers were found to associate different disgust faces with different disgust elicitors. This theoretical analysis echoed Ekman's (1992) metaphor that emotion categories are families and is consistent with the prototype perspective on emotion categories in which exemplars of each emotion category share a family

resemblance to one another rather than a set of necessary and sufficient features (Fehr et al. 1982; Fehr and Russell 1984). Rozin et al.'s analysis was later supported by research on the production of facial expressions. Weiland et al. (2010) found that different aversive tastes and odors elicit different AUs (including 6, 7, 10, 25, and 26).

Rozin et al. (1994) interpreted their findings in the framework of facial expressions as signals, but another possibility is that the various disgust faces are cues rather than signals. Perhaps observers see a facial configuration as a "serviceable" action (such as wrinkling the nose to block an odor or opening the mouth to spit something out). From that initial interpretation, the observer can infer, especially if asked to make an explicit judgment, what emotional state might accompany that action. In light of Rozin et al.'s findings and the generally weak results with the standard disgust face, we returned to Darwin's suggestion that the facial movements of extreme disgust are preparations for vomiting. We wondered if a more recognizable facial movement for disgust would be someone about to vomit. To explore this issue, we asked a professional actress to draw on her experience in film and on stage to convey to an audience that she felt sick and was about to vomit. The result was the "sick face," an example of which is shown in the right panel of Fig. 1. Scored with Ekman, Friesen, and Hager's (2002) FACS, the sick face is AU 6 (cheeks raised), AU 7 (tight eyelids), AU 10 (raised upper lip), and AU 26 (dropped jaw). This configuration was not mentioned by Rozin et al. (1994) or by Ekman et al. (2002), but would likely be classified as an exemplar of disgust.

In two studies, observers were shown various facial expressions, including exemplars of the standard disgust face and the sick face. They were asked to select which of various emotions were expressed by each face and the intensity of each emotion.

Study 1

Method

Participants

Participants were 60 undergraduates at Boston College (30 male and 30 female) between the ages of 18 and 22 ($M_{age} = 19.1$). All participants were proficient in English and participated in the study in exchange for course credit.

Materials

Five different facial expressions were used, all posed by the same professional actress. The sad face, anger face, fear face, and standard disgust face (AUs 9 + 10) were posed according to recommendations of the FACS coding system (Ekman et al. 2002, Table 10–1). The sick face consisted of raised cheeks, raised lower eyelid, raised upper lip, and dropped jaw (AUs 6 + 7 + 10 + 26). Examples of the standard disgust face and sick face are shown in Fig. 1.

Procedure

Each participant was given one of six different orders of presentation[1]: The anger, disgust, and sick faces were rotated through the first, third, and fifth positions; the fear face was always the second face and the sad face was always the fourth face.

Faces were presented one at a time. For each face, participants were given eight emotion labels (*disgust, anger, sadness, fear, anxiety, contempt, shame,* and *suspicion*) and asked to indicate whether each emotion was shown in the face by circling either *yes* or *no* for each label. "No" was scored as 0. For any emotion label for which they circled *yes*, they were asked to rate intensity on a scale from 1 = barely to 7 = maximum.

Results

Which facial expression best expressed disgust?

The sick face was rated as expressing disgust more intensely than was the standard disgust face; this difference was significant, $t_{59} = 4.95$, $p < 0.001$, Cohen's $d = 0.65$. These results are illustrated in Fig. 2. The sick face was endorsed as expressing disgust by more participants than was the standard disgust face; the difference was significant, Yates correction $\chi^2_{df=1} = 4.57$, $p = 0.03$.[2]

Discriminant validity

Table 1 provides the mean intensity of each emotion attributed to each facial expression and the percentage of participants who agreed that a specific face expressed each emotion. The sick face was rated as expressing emotions other than disgust less intensely than did the standard disgust face for 6 of 7 emotions (all but shame). The difference between the sick face and the standard disgust face was significant (dependent sample t-tests) for anger, $t_{59} = 9.96$, $p < 0.001$, Cohen's $d = 1.28$; contempt, $t_{59} = 2.30$, $p = 0.02$, Cohen's $d = 0.30$; and suspicion, $t_{59} = 2.56$,

[1] A preliminary analysis indicated that presentation order had no main or interactive effects with the intensity ratings or endorsements of the disgust or sick faces.

[2] To avoid the inclusion of repeated measures data in the χ^2s in Study 1, only participants who labeled one or both faces as something other than *disgust* were included in the analysis. Participants who labeled both the standard disgust and sick faces as *disgust* were omitted.

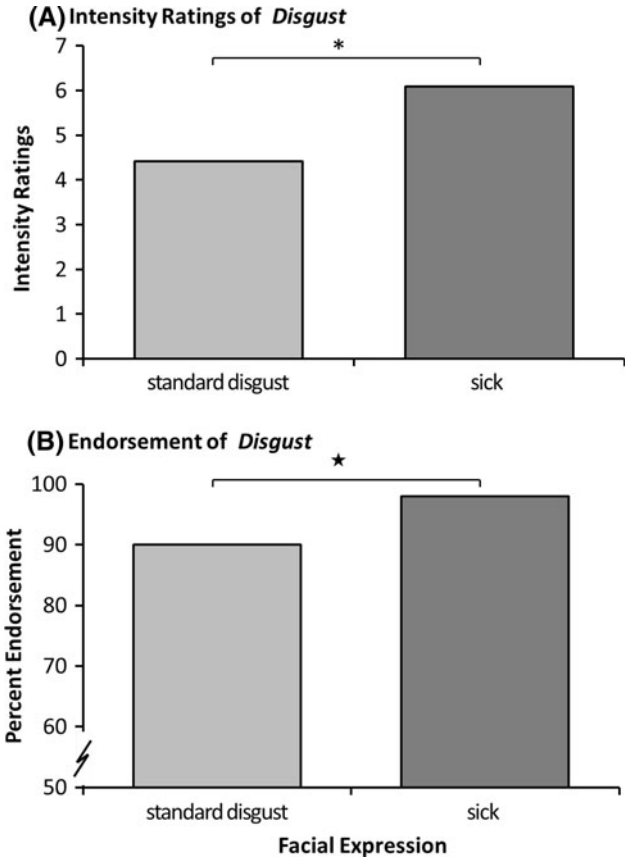

Fig. 2 Use of the label *disgust* for the standard disgust face and sick face. **a** Mean intensity ratings of disgust for each face. **b** Percentage of participants who endorsed each for disgust. *asterisk* Intensity: $t_{59} = 4.95$, $p < 0.001$ *star* Endorsement: *Yates correction* $\chi^2_{df=1} = 4.57$, $p = 0.03$

$p = 0.01$, Cohen's $d = 0.34$; and marginally significant for shame, $t_{59} = -1.81$, $p = 0.07$, Cohen's $d = 0.23$. Similarly, the sick face was endorsed as expressing emotions other than disgust less frequently than was the standard disgust face for 6 of 7 emotions (all but shame) and this difference was significant for anger, $\chi^2_{df=1} = 52.00, p < 0.001$, contempt, $\chi^2_{df=1} = 11.11$, $p < 0.001$, shame, Yates $\chi^2_{df=1} = 6.25, p = 0.01$, and anxiety, Yates $\chi^2_{df=1} = 4.50, p = 0.03$ (but not for fear or sadness).

Multiple emotions seen in each face

As shown in Table 1, a majority of observers endorsed *disgust*, *contempt*, and *anger* for the standard disgust face; *disgust* and *contempt* for the sick face; *anger*, *contempt*, and *suspicion* for the anger face; *fear* and *anxiety* for the fear face; and *sadness* and *shame* for the sad face. The intensity ratings mirrored these findings. No face emerged as expressing one and only one emotion (although if anxiety is taken to be a kind of fear, then perhaps the fear face would be an exception). Furthermore, requiring a majority to define endorsement oversimplifies the results: All faces were perceived as conveying several emotions, albeit to varying degrees, by at least some observers. The number of emotions endorsed, on average, was 3.27 for the standard disgust face, 3.18 for the anger face, 2.70 for the fear face, 2.62 for the sick face, and 2.55 for the sad face.

Table 1 Mean intensity and endorsement for emotions for five facial expressions, Study 1

	Facial expression				
Emotion label	Standard disgust	Sick	Anger	Fear	Sad
Intensity					
Disgust	4.4	6.1	1.6	0.7	0.3
Anger	4.2	1.6	5.5	0.0	0.3
Contempt	3.1	2.3	2.6	0.0	0.2
Suspicion	1.6	0.9	2.4	0.5	0.3
Anxiety	0.4	0.3	0.6	4.1	1.0
Sadness	0.2	0.1	0.8	0.8	6.1
Shame	0.2	0.5	0.4	0.6	2.0
Fear	0.3	0.1	0.1	6.6	1.2
Endorsement					
Disgust	90	98	40	25	10
Anger	92	48	98	0	10
Contempt	68	52	57	0	5
Suspicion	43	30	62	17	7
Anxiety	10	8	20	83	32
Sadness	8	3	22	28	98
Shame	8	18	13	17	55
Fear	7	3	7	100	38

For intensity ratings, *no* responses were scored as 0; *yes* responses were made on a 1–7 scale. Endorsement was the percentage of participants who selected *yes* for that emotion label. $N = 60$

Discussion

The sick face was rated by more observers as conveying disgust and as conveying a more intense disgust than was the standard disgust face combining AUs 9 and 10. The sick face also showed greater discriminant validity as a cue to disgust than did the standard disgust face. An additional result was that all of the facial expressions, with the possible exception of the fear face, showed weak discriminant validity in that each conveyed multiple emotions to some degree to some observers. Disgust was thus conveyed by all of the facial expressions studied, albeit to different degrees.

Study 2

In Study 2, we sought to replicate and extend the findings of Study 1. None of the facial expression exemplars used in Study 1 were used. All facial expressions save the sick face were selected from previously published standardized sets, and two sets of faces were used in order to replicate the results across particular exemplars. In each set, there were two exemplars of the standard disgust face, one displaying AU 9, the other displaying AU 10. The sad face used had an open mouth and was included to further explore the finding of Study 1 that faces purported to signal single basic emotions convey disgust to some degree. Two new versions of the sick face were created with two new actors.

Other aspects of method were changed to examine the robustness of findings in Study 1. The response rating form used in Study 1 had provided eight options, and it was conceivable that the length of the list contributed the large number of emotions selected. In Study 2, we narrowed the list so that each participant chose from four negative emotions (*disgust, anger, sadness*, and *fear*), each a purported discrete basic emotion; in this way, we eliminated alternatives such as *contempt, shame, anxious*, and *suspicious*. In Study 1, faces had been presented one at a time, and it was conceivable that some part of results were created by this order. In Study 2, participants saw eight preview faces (including the five faces they would rate in the next step) displayed one at a time for one second each. After the preview, the observer saw all five faces to be rated at the same time on a computer screen. Finally, we obtained a sample of participants from outside the university.

Method

The method was the same as in Study 1 except as noted.

Participants

Participants were 160 adults (71 males; $M_{age} = 33.2$). All participants completed the study online in exchange for compensation.

Materials

Each of two sets consisted of five different facial expressions each posed by a different white female: anger, sadness, sick, standard disgust face with AU 9, and standard disgust face with AU 10. Four of the five were taken from standard sets (Ekman and Friesen 1976; Tottenham et al. 2009; van der Schalk et al. 2011). The sick face was created in our lab with two new actresses in the same way that the sick face had been created for Study 1. Each type of facial expression used in the two sets showed good similarity according to the endorsement of the expected emotion (*disgusted* for AU 9, AU 10, and the sick face; *sad* for the sad face; and *angry* for the anger face): AU 9, Cohen's kappa = 0.59, 94 % agreement; AU 10, Cohen's kappa = 0.18, 90 % agreement; the sick face, Cohen's kappa = 0.66, 99 % agreement; the sad face, Cohen's kappa = 0.97, 99 % agreement; and the angry face, Cohen's kappa = 0.56, 96 % agreement.

Procedure

Participants were randomly assigned to see either the faces from set 1 or set 2. They first previewed eight faces (the five the test faces and three distractors) for one second each. They were then randomly assigned to one of two versions (one randomly ordered, one reversed) of the survey.[3] All five faces that each participant rated (endorsement and intensity) were visible at the same time on a computer screen. For each face, participants were given four emotion labels (*disgust, anger, sadness*, and *fear*).

Results

Which facial expression best expressed disgust?

The sick face was rated as expressing disgust significantly more intensely than either the standard disgust face with AU 9, $t_{159} = 4.74$, $p < 0.001$, Cohen's $d = 0.38$, or AU 10, $t_{159} = 4.04$, $p < 0.001$, Cohen's $d = 0.32$. The results are presented in Table 2. The sick face was endorsed as expressing disgust by a significantly greater percentage of participants than was either AU 9, $\chi^2_{df=1} = 16.10, p < 0.001$ or AU 10, $\chi^2_{df=1} = 9.53, p = 0.002$.[4]

Discriminant validity

Table 2 provides the mean intensity of each emotion attributed to each facial expression and the percentage of participants who agreed that a specific face expressed each emotion. The sick face expressed significantly less anger than the AU 9 disgust face (dependent sample t-tests) $t_{159} = 11.74$, $p < 0.001$, Cohen's $d = 0.98$, but not sadness, $t_{159} = 1.48$, $p = 0.14$; and expressed significantly more fear, $t_{159} = 2.37$, $p = .02$, Cohen's $d = 0.19$.

[3] As in Study 1, a preliminary analysis indicated that presentation order had no main or interactive effects with the intensity ratings or endorsements of the AU 9 disgust faces, AU 10 disgust faces, or sick faces.

[4] To avoid the inclusion of repeated measures data in the χ^2s in Study 2, only participants who labeled one or both faces as something other than *disgust* were included in the analysis. Participants who labeled both the standard disgust (either AU 9 or AU 10) and sick faces as *disgust* were omitted.

Table 2 Mean intensity and endorsement for emotions for five facial expressions, Study 2

	Facial expression				
Emotion label	Standard disgust (AU 9)	Standard disgust (AU 10)	Sick	Anger	Sad
Intensity					
Disgust	4.5	4.7	5.4	2.3	3.1
Anger	2.9	2.5	0.8	6.0	0.8
Sadness	0.6	0.5	0.4	0.3	3.5
Fear	0.3	0.5	0.5	0.4	1.3
Endorsement					
Disgust	89	92	98	47	66
Anger	66	56	19	97	18
Sadness	16	12	11	7	72
Fear	6	13	12	8	33

For intensity ratings, *no* responses were scored as 0; *yes* responses were made on a 1–7 scale. Endorsement was the percentage of participants who selected *yes* for that emotion label. N = 160

The sick face expressed significantly less anger than the AU 10 (dependent sample t-tests), $t_{159} = 9.35$, $p < 0.001$, Cohen's $d = 0.79$, but not sadness, $t_{159} = 0.68$, $p = 0.50$, or fear, $t_{159} = 0.41$, $p = 0.68$.

Similarly, the sick face was endorsed less frequently as expressing anger than was the AU 9 disgust face, $\chi^2_{df=1} = 133.56$, $p < 0.001$, and sadness $\chi^2_{df=1} = 5.33$, $p = 0.021$; the sick face was endorsed as expressing fear significantly more, $\chi^2_{df=1} = 7.71$, $p = 0.005$. The sick face was endorsed as expressing anger less frequently than was the AU 10 disgust face, $\chi^2_{df=1} = 101.94$, $p < 0.001$; but not sadness $\chi^2_{df=1} = .50$, $p = 0.48$, or fear, $\chi^2_{df=1} = .09$, $p = 0.77$.

Multiple emotions seen in each face

Table 2 provides the percentage of participants who agreed that a specific face expressed each emotion and the mean intensity of that emotion. Even with only four purported basic discrete emotions in the response scale, observers saw more than one emotion in each face: A majority saw both disgust and anger in each of the two standard disgust faces (AU 9 and AU 10); and sadness and disgust in the sad face. The intensity ratings showed the same pattern. On the other hand, the majority saw but one emotion in two of the faces: disgust for the sick face; anger for the anger face. The intensity ratings showed the same pattern. With a less stringent definition of endorsement, all faces conveyed all emotions to some observers to some extent. Participants endorsed on average 1.89 out of the 4 emotions for the sad face, 1.77 emotions for the standard disgust face (AU 9), 1.72 emotions for the standard disgust face (AU 10), 1.58 emotions for the anger face, and 1.39 emotions for the sick face.

General conclusion

The standard disgust face was found here to convey, to varying degrees, a mixture of emotions, especially anger and disgust, but other emotions as well. This finding stems from a change in response format. In most studies of the recognition of emotion from a facial expression, observers are forced to choose one emotion from a short list supplied by the experimenter (Frank and Stennett 2001; Russell 1994). This format presupposes rather than tests the assumption that each hypothesized facial expression conveys one specific emotion. Here, simply giving observers the opportunity to choose none (by saying "no" to each option), one, or multiple emotions showed that prior findings were molded by the response format. Studies based on that commonly used format might bear re-examination. Those studies that score someone as incorrect who fails to select *disgust* as the emotion conveyed by the standard disgust face may bear re-examination. Our results question whether selecting *anger* should be scored as correct.

The sick face we created has not been included in standardized sets and was not among the various disgust expressions studied by Rozin et al. (1994). The sick face does resemble prior proposed signals of disgust and would be classified as disgust by the criteria specified by Ekman et al. (2002). The sick face was endorsed more frequently as disgust and conveyed a more intense disgust than standard disgust faces. This finding raises questions about prior findings with the standard disgust face. For example, the person who failed to select *disgust* for the standard disgust face might well have selected *disgust* for the sick face. More generally, our findings augment Rozin et al.'s in showing that the set of faces in which observers see disgust is more diverse than commonly thought.

One interpretation of our findings is that the sick face rather than the standard disgust face is *the* signal of disgust. One problem with this interpretation is that it is then hard to explain how astute observers such as Tomkins and McCarter (1964), Ekman and Friesen (1971) and Izard (1971) missed it.

Considered together with the findings from Rozin et al. (1994), the present data support an alternative account of what happens when an observer attributes disgust to another on the basis of that person's facial expression. In this alternative account, disgust does not have a signal, but various expressions do serve as a *cue* to disgust. The variants of the expression—the standard disgust face with AU 9, that with AU 10, the sick face, and the variants studied by Rozin et al.—all involve facial movements blocking or ridding oneself of something, especially odors or tastes. All thus reliably convey to an observer that the expresser is confronting something aversive (which includes disgust elicitors, although *disgust* is a fuzzy concept; Nabi 2002). Aversive smells and aversive tastes are more consistent with the emotion of disgust than other emotions, but other emotions are also possible and hence endorsed to some degree.

Our study was based on but three exemplars of the sick face, each posed by a different actress, and many questions remain. For example, in order to compare the sick face with the standard disgust face, we used static photographs, but dynamic videos, ideally of spontaneous facial expressions, need to be studied. For a similar reason, our observers saw the various faces without information about the expresser's context, but evidence shows that both the expresser's context (Aviezer et al. 2008; Carroll and Russell 1996) and the observer's context (Pochedly et al. 2012; Russell and Fehr 1987) influence the interpretation of a facial expression. Less work has been done on measures of "recognition" that do not rely on emotion words. Because our study was preliminary, we do not speculate on these issues, but anticipate further unexpected findings.

Acknowledgments We thank Nicole Nelson, Mary Kayyal, Alyssa McCarthy, Nicole Trauffer, Cara D'arcy, and Marissa DiGirolamo for their comments on a draft of this article. This article was funded by a grant from the National Science Foundation (1025563).

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