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Running head: MODAL COGNITION

Differentiating “Could” from “Should”: Developmental Changes in Modal Cognition

Abstract

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7 Young children have difficulty distinguishing events that violate physical laws (impossible
8 events) from those that violate mere physical regularities (improbable events). They judge both
9 to be “impossible” (e.g., Shtulman & Carey, 2007). They also have difficulty distinguishing
10 events that violate moral laws (immoral events) from events that violate mere social regularities
11 (unconventional events). They judge both to be “wrong” (e.g., Tisak & Turiel, 1988). In this set
12 of studies, we explored the possibility that both difficulties arise from a more general deficit in
13 *modal* cognition, or the way that children represent and reason about possibilities. Participants
14 (80 children between the ages of three and ten and 101 adults) were shown impossible,
15 improbable, unconventional, and immoral events and asked to judge whether the events could
16 occur in real life and whether they would be okay to do. Preschool-aged children not only had
17 difficulty distinguishing law-violating events from regularity-violating events but also had
18 difficulty distinguishing the two modal questions themselves, judging physically abnormal
19 events (e.g., floating in the air) as immoral and socially abnormal events (e.g., lying to a parent)
20 as impossible. These findings were replicated in a second study in which participants (74
21 children and 78 adults) judged whether the events under consideration would require magic (a
22 specific consequence of impossibility) or would require punishment (a specific consequence of
23 impermissibility). Our findings imply that young children’s modal representations clearly
24 distinguish abnormal events from ordinary events but do not clearly distinguish different types of
25 abnormal events from each other. That is, the distinction between whether an event *could* occur
26 and whether an event *should* occur must be learned.
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Introduction

Predicting other people's behavior is a key part of daily life. We make these predictions on the basis of expectations that differentiate likely behaviors from unlikely ones. For instance, if we observe someone at a restaurant discover a fly in his soup, we expect him to ask the waiter for a new bowl of soup or possibly leave the restaurant. We do not expect him to eat the soup with the fly in it or to pull a new, uncontaminated bowl of soup out of his backpack. We also don't expect him to swap his bowl of soup for his dinner companion's when she is in the bathroom or to recite an incantation over the bowl to remove the fly by magic.

Expectations of this nature do not have to be learned situation by situation. Rather, they can be derived from two more general sources of information: social norms and physical regularities (Kalish, 1998; Levy, Taylor, & Gelman, 1995; Lockhart, Abrahams, & Osherson, 1977; Schmidt, Rakoczy, & Tomasello, 2011). Social norms dictate whether a behavior is socially acceptable, whereas physical regularities dictate whether a behavior is physically plausible. Moreover, some social norms specify behaviors that are unconventional but not necessarily immoral (e.g., eating the bowl of soup with the fly in it), whereas others specify behaviors that are patently immoral (e.g., surreptitiously swapping a contaminated bowl of soup with someone else's uncontaminated bowl). Likewise, some physical regularities specify behaviors that are improbable but not necessarily impossible (e.g., pulling a new bowl of soup out of one's backpack), whereas others specify behaviors that are patently impossible (e.g., using a magical incantation to remove the fly).

Most adults make categorical distinctions between these classes of events. They judge unconventional behaviors to be less wrong than immoral behaviors (Haidt, Koller, & Dias, 1993; Smetana, 1989; Zalla, Barlassina, Buon, & Leboyer, 2011), and they judge improbable events to

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4 be more plausible or more imaginable than impossible events (Barnes & Black, 2016; Nolan-
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7 Reyes, Callanan, & Haigh, 2016; Shtulman, 2009). Young children, on the other hand, do not
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9 make these same distinctions. Several studies (reviewed below) have found that preschool-aged
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11 children classify unconventional behaviors as morally wrong and improbable events as
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13 physically impossible. Children of this age know the social norms that make unconventional
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15 behaviors questionable and the physical regularities that make improbable events unlikely, but
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17 they do not robustly differentiate events that violate laws—either moral laws or physical laws—
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19 from those that violate mere regularities.
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24 Here, we aim to show that these two phenomena—mistaking improbable events for
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26 impossible events and mistaking unconventional events for immoral events—represent a general
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28 deficit in modal cognition, or the way that children represent and reason about possibilities. We
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30 show not only that changes in reasoning about physical possibility develop in tandem with
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32 changes in reasoning about moral permissibility but also that preschoolers' reasoning about
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34 physical possibility is not well differentiated from their reasoning about moral permissibility as a
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36 whole. In other words, we show that as children learn to differentiate what could occur in a given
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38 situation from what could *not*, they also learn to differentiate what *should* occur from what *could*
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40 occur in that situation.
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45 **Developmental Changes in Reasoning about Physical Possibility**

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48 By the age of four, children are adept at differentiating impossible events from ordinary
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50 events (Samuels & Taylor, 1994; Sobel, 2004; Schult & Wellman, 1997), judging both that the
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52 former could not happen in real life but the latter could and that the former would require magic
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54 to happen but the latter would not. This recognition extends to several types of impossible
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56 events: physically impossible events, like moving a marble just by thinking about it (Johnson &
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58 Harris, 1994), biologically impossible events, like growing from an adult back into a child
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4 (Rosengren, Kalish, Hickling, & Gelman, 1994), and psychologically impossible events, like
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6 knowing what a person ate just by looking at him (Browne & Woolley, 2004). Even preverbal
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8 infants appear to be sensitive to the distinction between impossible events and ordinary events,
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10 as revealed by several decades of looking-time experiments (Baillargeon, 2004; Spelke &
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12 Kinzler, 2007).
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16 Such findings demonstrate that preschoolers are sensitive to the regularities that govern
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18 the physical world and recognize when those regularities have been violated. However, they do
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20 not demonstrate that preschoolers are sensitive to the differences between events that are strictly
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22 precluded from occurring by laws (e.g., laws of physics) and events that are unlikely to occur but
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24 not strictly precluded. Indeed, four-year-olds claim not only that events that violate physical laws
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26 could not be done but also that events that violate social conventions could not be done (Browne
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28 & Woolley, 2004; Chernyak, Kushnir, Sullivan, & Wang, 2013; Kalish, 1998; Komatsu &
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30 Galotti, 1998; Lockhart et al., 1977). That is, they correctly claim that a person could not float in
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32 the air or walk through a wall, but they incorrectly claim that a person could not eat candy for
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34 dinner or take a bath with their shoes on.
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41 The ability to differentiate events that violate physical laws (impossible events) from
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43 those that violate other kinds of statistical regularities (improbable events) develops much later
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45 than the ability to differentiate events that violate physical laws from those that violate no
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47 regularities whatsoever (ordinary events). Several studies have now shown that preschoolers
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49 deny the possibility of events that adults uniformly judge to be possible, like owning a lion for a
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51 pet, drinking onion juice, or finding an alligator under the bed (Lane, Ronfard, Francioli, &
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53 Harris, 2016; Nolan-Reyes et al., 2016; Shtulman, 2009; Shtulman & Carey, 2007; Shtulman &
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55 Yoo, 2015; Weisberg & Sobel, 2012). Not until age ten do children robustly differentiate
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57 improbable events from impossible events, both in what they judge to be possible and how they
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4 justify those judgments. Four-year-olds justify their judgments of why an event is impossible by
5 citing events that would occur or could occur in place of the target event (e.g., walking through a
6 wall is impossible because “you would hit your head” or because “you could walk through a
7 door instead”). Ten-year-olds, on the other hand, justify their judgments by citing facts about the
8 world that preclude the events from occurring (e.g., walking through a wall is impossible
9 because “walls are hard and so are people”).

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19 Preschoolers’ inability to differentiate impossible events from improbable events is not
20 absolute: it varies by culture (Chernyak et al., 2013), by task (Weisberg & Sobel, 2012), and by
21 context (Komatsu & Galotti, 1998). Nevertheless, preschoolers are several times less likely to
22 affirm the possibility of an improbable event than adults are, and teaching preschoolers to
23 differentiate improbable events from impossible events has proven largely ineffective (Lane et
24 al., 2016; Shtulman & Carey, 2007). Preschoolers do not appear to question whether an
25 improbable event violates a law or just a regularity. Instead, they view the fact that it violates a
26 regularity as *prima facie* evidence of impossibility (see Woolley & Ghossainy, 2013).

27 28 29 30 31 32 33 34 35 36 37 38 **Developmental Changes in Reasoning about Moral Permissibility**

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41 Just as preschoolers readily identify events that violate physical laws as impossible, they
42 readily identify events that violate moral laws as impermissible (Cushman, Sheketoff, Wharton,
43 & Carey 2013; Smetana, 1981). By age four, they recognize that intentionally deceiving
44 someone, intentionally hurting someone, or intentionally damaging someone’s property is wrong
45 and deserves punishment. Moreover, even fifteen-month-old infants show some sensitivity to
46 unfair behavior (Schmidt & Sommerville, 2011), and twelve-month-old infants are sensitive to
47 the distinction between helping someone and harming someone (Hamlin, Wynn, & Bloom, 2007;
48 Hamlin & Wynn, 2011).

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4 At the same time, preschoolers have trouble differentiating events that violate moral laws,
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6 like hitting and stealing, from those that violate mere social regularities, like not participating in
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8 show-and-tell or not sitting on the rug during story time. Although several studies have shown
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10 that preschoolers are able to differentiate moral transgressions from conventional transgressions
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12 when averaged across items and across children (Dahl & Kim, 2014; Haidt et al., 1993; Nucci,
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14 1981; Turiel, 2008), the size of that distinction is small. Consider, for instance, Smetana's (1981)
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16 finding that preschoolers rate moral transgressions as more serious, more punishable, less rule-
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18 dependent, and less context-dependent than conventional transgressions. Children as young as
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20 three provided different ratings for the two types of transgressions, but they still rated
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22 conventional transgressions as wrong. That is, they typically rated conventional transgressions as
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24 "very bad" (versus "very, very bad") and as deserving "a little punishment" (versus "a lot of
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26 punishment"), and about a third claimed that conventional transgressions would still be wrong if
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28 there were no rule prohibiting them or if they were performed in a different context (e.g., at
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30 home rather than at school).
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38 In fact, children as old as ten continue to view conventional transgressions as wrong.
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40 When Tisak and Turiel (1988) asked fifth graders about the permissibility of wearing pajamas to
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42 school, 59% claimed it would be wrong for the school to allow children to wear pajamas, 55%
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44 claimed it would be wrong for children to wear pajamas even if the school did not prohibit it, and
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46 50% claimed it would be wrong for children to wear pajamas even if it were expressly allowed
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48 by the school principal. Thus, just as children often deny the possibility of events that are
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50 unusual but not impossible, they also often deny the permissibility of events that are unusual but
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52 not immoral.
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57 **Developmental Changes across Modal Domains**

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4 Both of the domains reviewed above—the domain of physical possibility and the domain
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6 of moral permissibility—involve reasoning about non-actual events, and thus recruit children’s
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8 capacity for modal cognition. In both cases, young children are able to discriminate between
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10 abnormal events and ordinary events, but they are not able to discriminate among separate
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12 classes of abnormal events, at least not robustly. They lump violations of physical regularities
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14 (improbable events) with violations of physical laws (impossible events), and they lump
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16 violations of social regularities (unconventional events) with violations of social laws (immoral
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18 events). We propose that this parallel is not a coincidence but rather is a general feature of
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20 children’s modal cognition. Specifically, children first come to understand whether or not an
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22 event can occur without representing the particular constraints that preclude particular events
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24 from occurring. Only later do they develop the ability to differentiate the reasons why such
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26 events cannot (or do not) occur, allowing them to distinguish more clearly between improbable
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28 and impossible events and between unconventional and immoral events.
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36 If this is correct, and young children’s modal cognition represents all precluded events as
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38 similar, then it follows that young children should experience difficulty making modal
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40 discriminations *across* domains as well as *within* domains. That is, they should have difficulty
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42 distinguishing the permissibility of socially anomalous events from the permissibility of
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44 physically anomalous ones, and they should have difficulty distinguishing the possibility of
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46 physically anomalous events from the possibility of socially anomalous ones.
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50 While this prediction may initially seem surprising, there are a number of reasons to think
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52 the distinction between physical possibility and moral permissibility may not be an inherent
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54 feature of modal cognition. First, across languages, there are modal terms that are consistently
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56 used both when talking about possibility and when talking about permissibility (Kratzer, 2012;
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58 Matthewson, 2016; Nauze, 2008). In English, for example, universal modal auxiliaries such as
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4 “must” and “have to” are used to make claims about physical necessity (e.g., “objects have to
5 obey the laws of gravity”) as well as claims about moral obligation (e.g., “children have to obey
6 their parents”). Likewise, existential modal auxiliaries such as “can” and “may” are used to make
7 claims about physical possibility (e.g., “there may be an even number of stars”) as well as claims
8 about moral permissibility (e.g., “you may drive 45 miles per hour”). In general, children are not
9 confused about the meaning of modal auxiliaries; they appropriately comprehend and produce
10 these terms in a well-defined space of possibilities (Byrnes & Duff, 1989; Ozturk & Papafragou,
11 2015). However, the terms themselves often cut across domains, appearing in both physical and
12 moral contexts (Johnson-Laird, 1978).
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26 Second, studies with adults have demonstrated a number of different way in which
27 reasoning about what can physically occur tracks reasoning about what is morally good (Barnes
28 & Black, 2016; Bear & Knobe, in press; Tworek & Cimpian, 2016; Young & Phillips, 2011).
29 These findings suggest that the domains of physical possibility and moral permissibility may not
30 be entirely separate even for adults. For instance, Shtulman and Tong (2015) asked college-
31 educated adults to consider the physical possibility of several extraordinary events (e.g., bringing
32 an extinct species back to life, teleporting an object to a distant location), as well as the moral
33 permissibility of several extraordinary actions (e.g., replacing a borrowed necklace with an exact
34 copy, using an American flag to clean the toilet). They found that adults’ tendency to judge
35 physically extraordinary events possible predicted their tendency to judge morally extraordinary
36 actions permissible, even when controlling for other predictors of moral judgment (e.g., disgust
37 sensitivity). They also found that participants’ justifications for their judgments were correlated
38 across domains, with some participants focusing on identifying principles violated by the events
39 at hand and others focusing on identifying circumstances under which the events could occur or
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4 should occur. These findings suggest that reasoning about physical possibility and reasoning
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6 about moral permissibility draw upon common cognitive resources even for adults.
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9 Third, young children have been shown to conflate physical possibility and moral
10 permissibility in judging the possibility of morally impermissible events. Phillips and Bloom
11 (2017) asked children between the ages of four and seven to judge the possibility of three kinds
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13 of events: improbable events, like being given 100 identical shirts; impossible events, like
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15 turning a hat into a candy bar; and immoral events, like taking a ball from another child. They
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17 found that children not only denied the possibility of improbable events (as shown in previous
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19 research) but also denied the possibility of immoral events. In fact, four- and five-year-olds
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21 denied the possibility of immoral events as often as they denied the possibility of impossible
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23 events. Similarly, when adults are forced to make judgments of possibility under severe time
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25 pressure, they also tend to judge that immoral events are impossible (Phillips & Cushman, 2017).
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33 These three sets of findings suggest that when considering non-actual events, modal
34 cognition may not clearly differentiate what is physically impossible from what is morally
35 wrong. We attempted to confirm this hypothesis by asking preschool- and elementary-school-
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37 aged children to judge *both* the physical possibility and the moral permissibility of various kinds
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39 of events: events that violate physical laws (impossible events), events that violate physical
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41 regularities but not physical laws (improbable events), events that violate moral laws (immoral
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43 events), events that violate social conventions but not moral laws (unconventional events), and
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45 events that violate no laws or regularities whatsoever (ordinary events). Our prediction was that
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47 young children would not only have difficulty differentiating law-violating events from
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49 regularity-violating events within a given domain (impossible vs. improbable and immoral vs.
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51 unconventional), but would also have difficulty differentiating events *across* domains, judging
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4 impossible and improbable events to be morally wrong and judging immoral and unconventional
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6 events to be impossible.
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8 9 **Study 1**

10 11 **Method**

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14 **Participants.** Eighty children and 101 adults participated in Study 1. The adults were
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16 recruited from introductory psychology and cognitive science courses at Occidental College and
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18 were compensated for their participation with extra credit in those courses. The children were
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20 recruited from local parks and tested on site. Seventy-one percent of the adults were female, and
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22 55% of the children were female. Participants were not asked for information about their race,
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24 but they were sampled from racially diverse populations. The adults were sampled from a
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26 population that was 52% Caucasian, 14% Latino, 14% Asian, 5% African-American, and 15%
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28 other, and the children were sampled from a population that was 42% Caucasian, 25% Latino,
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30 10% Asian, 10% African American, and 13% other.
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36 The children ranged in age from 3.5 to 10.5. For the purposes of data analysis, we divided
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38 them into a younger group (3.5-5.8 years, $M = 4.7$, $n = 47$) and an older group (6.4-10.5 years, M
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40 $= 8.2$, $n = 33$). We chose age six as our dividing line because it roughly splits preschoolers from
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42 elementary schoolers. Some older five-year-olds may have been in kindergarten at the time of
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44 testing, but they would not yet have completed a full year.
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49 **Materials.** Participants were presented with eight vignettes, each of which consisted of a
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51 problem followed by five resolutions to that problem. The resolutions instantiated the five types
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53 of events mentioned above: ordinary, impossible, improbable, unconventional, and immoral. For
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55 each resolution, participants judged whether it was possible or whether or it was permissible. The
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57 vignettes were presented in one of four random orders, and each was illustrated with a
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4 photograph depicting the problem at hand. The entire set of vignettes can be found in the
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6 Appendix.

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9 As an illustration, one vignette was presented to participants as follows: “This is Melissa.
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11 Melissa doesn’t want to go to school because she doesn’t want to leave her mother. She always
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13 misses her mother a lot when she goes to school.” Participants were then presented with five
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15 potential resolutions to this problem: “Melissa and her mother agree to do something special
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17 after school and that makes Melissa feel happy” (an ordinary event); “Melissa snaps her fingers
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19 and suddenly it’s Saturday so she doesn’t have to go to school” (an impossible event); “Melissa
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21 asks her mother to go to school with her, and her mother agrees and goes to all her classes” (an
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23 improbable event); “Melissa decides to wear her pajamas to school because wearing pajamas
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25 make her feel happy” (an unconventional event); and “Melissa lies to her mother and tells her
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27 that school is closed today so that she doesn't have to go” (an immoral event). The events were
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29 presented in a random order, as they were for all vignettes.
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36 For our improbable events, we chose events that were difficult to conceive but possible
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38 nonetheless—i.e., *conceptually* improbable events. We focused on conceptual improbability
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40 rather than statistical improbable because young children are not confused about the distinction
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42 between probability and possibility in general. They recognize, for instance, that it is possible to
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44 pull a red marble from a bag containing ten blue marbles and one red marble but that it is
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46 impossible to pull a yellow marble from the same bag (Shtulman & Carey, 2007; see also
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48 Horobin & Acredolo, 1989; Sophian & Somerville, 1988). The notion of possibility that young
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50 children have difficulty grasping is possibility with respect to unlikely conceptual combinations
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52 (e.g., the possibility of finding an alligator under the bed).
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57 For our unconventional events, we chose events that are socially anomalous but not
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59 overtly harmful. Some exemplified disregard for personal wellbeing (e.g., a child searching
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4 through the trash at a birthday party for leftover cake), some exemplified disregard for social
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6 conventions (e.g., a child cleaning her room by shoving her clothes under her bed), and some
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8 exemplified disregard for in-group norms (e.g., a child tattling on a classmate to obtain a ball that
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10 her classmate has monopolized). While this collection may seem heterogeneous on its surface, it
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12 coheres at a deeper level in that none of our unconventional events instantiated direct,
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14 intentionally-caused harm, as our immoral events did. This distinction was validated by our adult
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16 participants, who consistently judged the unconventional events as less wrong (Study 1) and less
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18 punishable (Study 2) than the immoral events.
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23 **Procedure.** At the beginning of the experiment, participants were introduced to the task
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25 of making possibility or permissibility judgments in the context of a training phase. For
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27 possibility judgments, participants were told, “What we’re going to talk about now is whether
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29 certain things can happen in the real world. Some things that happen in stories can also happen in
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31 the real world and some things cannot—they’re impossible.” They were then shown four
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33 pictures—a boy playing a trombone, a woman sitting on a cloud, a girl painting a picture, and a
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35 boy eating a plate of lightning—and asked to decide whether each of the depicted events was
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37 possible or impossible. Correct answers were reaffirmed by the experimenter, and incorrect
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39 answers were corrected. For permissibility judgments, participants were told, “What we’re going
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41 talk about now is whether certain things are okay for a person to do. Some things that happen in
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43 stories are okay for a person to do and some things are not—they’re wrong.” They were then
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45 asked to judge the permissibility of four events: a girl sharing her snack with a friend, a girl
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47 pulling another girl’s hair, a boy playing a game with his friends, and a boy hitting another boy.
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49 Correct answers were reaffirmed, and incorrect answers were corrected. Overall, participants
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51 needed very little correction.
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4 After completing the training phase, participants judged the possibility or permissibility
5 of 40 events: five events for each of the eight vignettes. Possibility and permissibility judgments
6 were elicited in blocks. Half of the participants made possibility judgments before permissibility
7 judgments, and half did the opposite. The vignettes were counterbalanced across blocks so that
8 participants made only one type of judgment per vignette (e.g., half made possibility judgments
9 for the vignette about Melissa not wanting to go to school, and half made permissibility
10 judgments instead).

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12 Both types of judgments were elicited using a two-step procedure. For possibility
13 judgments, participants were first asked whether the event could occur in real life. If they
14 answered “yes,” the experimenter moved onto the next event. If they answered “no,” the
15 experimenter asked whether the event was “sorta impossible” or “very impossible.” For
16 permissibility judgments, participants were first asked whether the event was okay for someone
17 to do in real life. If they answered “yes,” the experimenter moved onto the next event. If they
18 answered “no,” the experimenter asked whether the event was “sorta wrong” or “very wrong.”
19 This protocol was used for both children and adults. That is, even the adults were tested in one-
20 on-one interviews with an experimenter.

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22 Our motivation for using a three-point scale was to allow participants to make modal
23 distinctions among events that might otherwise be conflated on a two-point scale. Consider the
24 immoral event of lying to your mother and the unconventional event of wearing pajamas to
25 school. If we had asked participants only whether these events are wrong, many participants
26 would likely have said “yes” to both, since wearing pajamas is a violation of the dress code at
27 most schools. By asking a follow-up question about degree of wrongness, participants were able
28 to clarify that wearing pajamas to school is only sorta wrong, whereas lying to your mother is
29 very wrong (if that was, in fact, what they believed).

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4 That said, we were concerned that our youngest participants (preschoolers) might have
5 difficulty using a three-point scale. We thus administered the scale in two parts so that children
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7 only ever had to make a dichotomous decision (e.g., “okay” vs. “wrong,” followed by “sorta
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9 wrong” vs. “very wrong”). We also verified that children’s answers to the first question were in
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11 line with previous research on children’s possibility judgments and permissibility judgments and
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13 that children applied our scale to the control items in an adult-like manner, implying that they
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15 understood its meaning.
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21 **Scoring.** For each possibility judgment, participants received a score of 0 if they claimed
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23 the event could happen in real life, a score of 1 if they claimed the event was “sorta impossible,”
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25 and a score of 2 if they claimed the event was “very impossible.” For each permissibility
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27 judgment, participants received a score of 0 if they claimed the event was okay to do in real life,
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29 a score of 1 if they claimed the event was “sorta wrong,” and a score of 2 if they claimed the
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31 event was “very wrong.” For each participant, these scores were then averaged across the four
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33 events within each category within each judgment block (e.g., scores for the four improbable
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35 events within the possibility-judgment block), resulting in a mean score ranging from 0 to 2 for
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37 each type of event and each type of judgment.
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43 **Analysis plan.** We analyzed participants’ scores in three ways. First, we focused on how
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45 participants answered the first question in our two tiers of questioning, looking for
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47 developmental differences in how often they judged the four types of events possible and
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49 permissible. This analysis was intended to establish that younger participants were less likely
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51 than older participants to recognize that violations of mere regularities are still possible and
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53 permissible (as found in previous studies).
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58 Second, we investigated participants’ ability to differentiate events that violate laws from
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60 events that do not *within* each domain. We did this by subtracting their scores for regularity-
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4 violating events from their scores for the corresponding law-violating events. For questions
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6 about physical possibility, participants' mean scores for judgments of immoral events, judgments
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8 of improbable events, and judgments of unconventional events were subtracted from their mean
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10 score for judgments of impossible events. This analysis resulted in three difference-scores which
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12 indicate whether participants differentiated each kind of event from events that clearly violate
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14 physical laws. A similar approach was taken for judgments of permissibility. Participants' mean
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16 scores for judgments of impossible events, judgments of improbable events, and judgments of
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18 unconventional events were subtracted from their mean score for judgments of immoral events.
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20 This analysis resulted in three difference-scores which indicate whether participants
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22 differentiated each kind of event from events that clearly violate moral rules. For both sets of
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24 difference scores, the higher the score, the more strongly participants distinguished events that
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26 violate a domain-specific law (e.g., a physical law) from events that do not. We used this metric
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28 to assess developmental differences in participants' ability to make distinctions within the
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30 domains of physical possibility and moral permissibility.
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38 Third, we computed difference scores *across* domains. For simplicity, we focused on
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40 immoral and impossible events. In each case, we took participants' permissibility scores and
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42 subtracted them from their possibility scores for the same kind of event. This resulted in two
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44 difference-scores for each participant, which indicate whether they thought immoral events were
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46 more immoral than impossible, and conversely, whether they thought impossible events were
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48 more impossible than immoral. On this metric, positive scores indicated stronger judgments that
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50 the event is impossible but not impermissible, and negative scores indicated stronger judgments
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52 that the event is impermissible but not impossible. We analyzed this metric as a way of assessing
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54 developmental differences in participants' capacity to differentiate the modal domains
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56 themselves.
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Note that between-domain difference scores were computed within participants but that judgment type was counterbalanced across participants, meaning that for any given event, participants judged its possibility or its impermissibility but not both. Difference scores thus reflect participants' ability to differentiate possibility from permissibility in general rather than for their ability to do so for particular events. Future research should explore whether children's ability to differentiate possibility from permissibility is improved by considering both questions for the same event.

Results

Control items. We treated participants' mean judgments for the ordinary events as a control. We compared those means to a score of 1.0, which corresponded to "sorta impossible" in the domain of physical possibility and "sorta wrong" in the domain of moral permissibility. In both domains, the mean score for all age groups was significantly less than 1.0 (younger children: M possibility score = 0.25, $t(46) = 12.39$, $p < .001$; M permissibility score = 0.24, $t(46) = 14.45$, $p < .001$; older children: M possibility score = 0.03, $t(32) = 53.67$, $p < .001$; M permissibility score = 0.13, $t(32) = 20.59$, $p < .001$; adults: M possibility score = 0.01, $t(100) = 285.69$, $p < .001$; M permissibility score = 0.02, $t(100) = 121.82$, $p < .001$). Even the younger children had no difficulty answering questions about possibility and permissibility for ordinary events; they judged them possible and permissible significantly more often than they did for the four types of abnormal events (for all comparisons, $t(46) > 4.0$, $p < .001$). These findings confirm that participants of all ages understood the task and used the scale appropriately. All remaining analyses focus solely on the abnormal events.

Within-domain distinctions. Participants' tendency to judge each type of event as simply possible or permissible is displayed in Table 1. We used one-way analyses of variance (ANOVAs) to assess the effects of age group on each type of judgment for each type of event.

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4 Participants' tendency to judge particular events possible *increased* with age for improbable
5 events ($F(2,178) = 18.64, p < .001, \eta^2 = .17$), unconventional events ($F(2,178) = 67.07, p < .001,$
6 $\eta^2 = .43$), and immoral events ($F(2,178) = 54.59, p < .001, \eta^2 = .38$), but *decreased* with age for
7 impossible events ($F(2,178) = 31.38, p < .001, \eta^2 = .26$). Contrast analyses confirmed that these
8 effects varied linearly across age groups (impossible events: $F(1,178) = 62.44, p < .001, \eta^2 = .26$;
9 improbable events: $F(1,178) = 36.28, p < .001, \eta^2 = .17$; unconventional events: $F(1,178) =$
10 $131.07, p < .001, \eta^2 = .42$; immoral events: $F(1,178) = 106.66, p < .001, \eta^2 = .37$).

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Participants' tendency to judge particular events permissible *increased* with age for
impossible events ($F(2,178) = 3.28, p = .040, \eta^2 = .04$) and unconventional events ($F(2,178) =$
 $5.19, p = .006, \eta^2 = .06$) but *decreased* with age for the immoral events ($F(2,178) = 12.87, p <$
 $.001, \eta^2 = .13$). Once again, contrast analyses confirmed that these effects were linear in nature
(impossible events: $F(1,178) = 5.64, p = .019, \eta^2 = .03$; unconventional events: $F(1,178) = 9.40,$
 $p = .003, \eta^2 = .05$; immoral events: $F(1,178) = 25.55, p < .001, \eta^2 = .13$). The only set of
judgments for which age effects were not observed were permissibility judgments for the
improbable events ($F(2,178) = 2.19, p = .115, \eta^2 = .02$); older children and adults judged these
events as “sorta wrong” more than expected.

Difference scores between law-violating events and regularity-violating events are
displayed in Figure 1. For both types of judgments—possibility judgments and permissibility
judgments—younger children differentiated law-violating events (e.g., lying to a parent) from
the other types of events (e.g., wearing pajamas to school, bringing a parent to school) to a lesser
degree than older children did, and older children differentiated law-violating events from the
other types of events to a lesser degree than adults did. To confirm the reliability of this finding,
we submitted each set of difference scores to a 3 x 3 mixed-measures ANOVA, in which event
comparison (e.g., impossible/immoral vs. impossible/improbable vs. impossible/unconventional)

was entered as a within-participants factor and age group (younger children vs. older children vs. adults) was entered as a between-participants factor.

For possibility judgments, this analysis revealed main effects of event comparison ($F(2,356) = 10.06, p = .001, \eta^2 = .01$) and age group ($F(2,178) = 130.39, p < .001, \eta^2 = .54$), as well as a marginal interaction between them ($F(4,356) = 2.35, p = .054, \eta^2 = .01$). With respect to the events, improbable events were differentiated from impossible events less than immoral events were ($M = 1.27$ vs. $M = 1.38, t(360) = -2.33, p = .020, d = 0.25$). Likewise, improbable events were differentiated from impossible events less than unconventional events were ($M = 1.27$ vs. $M = 1.42, t(360) = -1.99, p = .047, d = 0.21$), but unconventional events were differentiated from impossible events no less than immoral events were ($t(360) = -0.49, p = .625, d = 0.05$). With respect to age, younger children differentiated impossible events from other events less than older children did ($M = 0.49$ vs. $M = 1.31, t(238) = -9.35, p < .001, d = 1.23$), and older children differentiated impossible events from other events less than adults did ($M = 1.77, t(112) = -6.51, p < .001, d = 1.07$). The marginal interaction occurred because the degree of differentiation among event types was not equivalent across age groups.

The same basic pattern was observed for impermissibility judgments. A mixed-measures ANOVA revealed a main effects of event comparison ($F(2,356) = 4.33, p = .014, \eta^2 = .01$) and age group ($F(2,178) = 30.93, p < .001, \eta^2 = .17$) but no interaction between them ($F(4,356) = 1.61, p = .17, \eta^2 = .01$). With respect to the events, unconventional events were differentiated from immoral events less than improbable events were ($M = 0.93$ vs. $M = 1.07, t(360) = -2.34, p = .020, d = 0.25$) and less than impossible events were ($M = 0.93$ vs. $M = 1.03, t(360) = -1.479, p = .140, d = 0.155$), but improbable events were differentiated from immoral events no less than impossible events were ($t(360) = 0.53, p = .594, d = 0.06$). With respect to age, younger children differentiated immoral events from other events less than older children did ($M = 0.63$ vs. $M =$

0.88, $t(238) = -3.097$, $p = .002$, $d = 0.41$), and older children differentiated immoral events from other events less than adults did ($M = 0.88$ vs. $M = 1.22$, $t(112) = -5.31$, $p < .001$, $d = 0.62$).

In sum, we found consistent effects of event type and age group for both possibility judgments and permissibility judgments. The effects of event type, however, were substantially smaller than the effects of age group (possibility judgments: $\eta^2 = .01$ vs. $\eta^2 = .54$, permissibility judgments: $\eta^2 = .01$ vs. $\eta^2 = .17$), indicating that participants differentiated regularity-violating events from law-violating more or less equivalently for different types of regularity-violating events, but their ability to do so increased dramatically with age.

Between-domain distinctions. The above analyses establish that older participants were better than younger participants at differentiating events that violate laws (physical or moral) from those that do not when assessing the events' physical possibility or moral permissibility. But how well did participants differentiate the modal questions themselves—i.e., the question of whether something is physical possibility and the question of whether something is morally permissible?

To investigate, we assessed the effects of age on participants' between-domain difference scores (described above) using one-way ANOVAs. These analyses confirmed that between-domain difference scores varied by age groups both for the impossible events ($F(2,178) = 25.87$, $p < .001$, partial $\eta^2 = .23$) and the immoral events ($F(2,178) = 57.44$, $p < .001$, partial $\eta^2 = .39$). Contrast analyses confirmed that these scores increased linearly across age groups for the impossible events ($F(1,178) = 47.97$, $p < .001$, partial $\eta^2 = .21$) but decreased linearly across age groups for the immoral events ($F(1,178) = 111.81$, $p < .001$, partial $\eta^2 = .39$). In other words, younger participants were less likely than older participants to differentiate the question of whether something is possible from the question of whether something is permissible, both when considering events that violate physical laws but not moral laws (e.g., traveling back in time) and

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4 when considering events that violate moral laws but not physical laws (e.g., intentionally tripping
5 someone). This relationship was observed even when adults were excluded from the analysis and
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7 children were compared to each other in terms of their age in months. Children's age in months
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9 was correlated both with stronger impossibility scores relative to impermissibility scores for the
10 impossible events ($r(80) = .24, p < .05$) and with stronger impermissibility scores relative to
11 impossibility scores for the immoral events ($r(80) = -.55, p < .001$).
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18 **Discussion**

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21 For each modal question, adults strongly differentiated events that violate question-
22 relevant laws from those that violate mere regularities. They also differentiated the questions
23 themselves, judging impossible events as impossible but not impermissible and judging immoral
24 events as impermissible but not impossible. Children's differentiation of event types and
25 question types was less pronounced, particularly for younger children. Younger children, as a
26 group, showed evidence of making within-domain distinctions and between-domain distinctions,
27 but the size of those distinctions was small relative to the distinctions made by older participants.
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38 Our findings replicate previous findings demonstrating that preschoolers have difficulty
39 making modal distinctions both within the domain of physical possibility (e.g., Shtulman &
40 Carey, 2007) and within the domain of moral permissibility (e.g., Tisak & Turiel, 1988). They
41 extend those findings by showing (a) that children's ability to make modal distinctions in the
42 domain of physical possibility develops in tandem with their ability to make modal distinctions
43 in the domain of moral permissibility and (b) that children must learn not only to distinguish
44 different types of events within the same domain but also to distinguish the domains themselves.
45 This latter finding is particularly striking. When younger children were presented with events
46 like floating in the air or conjuring a ball from nowhere, they claimed not just that those events
47 were impossible but also that they were impermissible. Conversely, when presented with events
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4 like stealing a candy bar or lying to a parent, they claimed not just that those events were
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6 impermissible but also that they were impossible. For many young children, the question of
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8 whether something could happen in real life and the question of whether something is okay to do
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10 merited surprisingly similar responses.
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14 One unexpected finding is that many older children and adults judged impossible events
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16 and improbable events as “sorta wrong.” These judgments may reflect the same disposition seen
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18 in young children but to a lesser degree; however, a more likely explanation is that older
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20 participants interpreted our questions in unintended ways. Take, for example, the vignette about
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22 Melissa not wanting to go to school. The improbable event was that “Melissa asks her mother to
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24 go to school with her, and her mother agrees and goes to all her classes,” and the impossible
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26 events was that “Melissa snaps her fingers and suddenly it’s Saturday so she doesn’t have to go
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28 to school.” In both cases, Melissa attempts to sidestep her problem rather than confront it head
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30 on, and participants may have focused on the nature of the solution rather than the principles
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32 violated by the solution (see Study 2 for evidence consistent with this interpretation).
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38 Concerns of this nature could, in fact, apply to the developmental differences we
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40 observed as well. While we have argued that the developmental changes observed in Study 1
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42 reflect changes in how children evaluate the modal status of abnormal events, an alternative
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44 interpretation is that they reflect changes in how children understood the modal questions
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46 themselves. For example, it is possible that young children understood the question of whether
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48 something was possible as a question about general plausibility rather than possibility, and they
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50 may have understood the question about whether something was wrong as a question about
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52 general oddness rather than permissibility. In other words, young children’s failure to
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54 distinguish between physical and social considerations when making modal judgments may have
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56 been a product of how they interpreted the particular questions we asked them.
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To investigate this possibility, we repeated Study 1 using the same materials and the same age groups but changed our questions. Instead of asking whether something could happen in real life, we asked whether the event would take *magic* to happen. And instead of asking whether something was okay to do, we asked whether the actor who performed that action could be *punished* for it. Our rationale was that the terms “magic” and “punishment” unambiguously apply to physical and social domains, respectively. These terms are not particularly susceptible to alternative interpretations, and young children have a relatively robust understanding of both (see, for example, Johnson & Harris, 1994, on young children’s understanding of magic).

Study 2

Method

Participants. Seventy-four children and 78 adults participated in Study 2. The adults were recruited from Amazon Mechanical Turk and paid for their participation. The children were recruited from local parks and tested on site. Fifty-nine percent of the adults were female, and 70% of the children were female. The children ranged in age from 3.5 to 10.1 and were divided once again into a younger group (3.5-5.9 years, $M = 4.9$, $n = 28$) and an older group (6.0-10.1 years, $M = 7.6$, $n = 46$) based on whether they were younger or older than six.

Procedure. The materials and the protocol were identical to Study 1 with the exception that participants’ judgments of physical possibility were elicited with a question about magic and their judgments of moral permissibility were elicited with a question about punishment. That is, the question “could that happen in real life?” was changed to “would that take magic to happen?” and the question “is that okay for him/her to do?” was changed to “could he/she get punished for doing that?” As in Study 1, both questions were followed by a second question if the participants answered “yes.” For the magic question, participants were asked whether the event required “a little magic” or “a lot of magic,” and for the punishment question, participants were asked

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4 whether the actor deserved “a little punishment” or “a lot of punishment.” One other point of
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6 difference between Study 1 and Study 2 is that the adults in Study 2 completed the survey as an
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8 online questionnaire rather than as an in-person interview. The ordering and content of the events
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10 were the same, however.
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14 **Scoring and Analysis.** For magic judgments, participants received a score of 0 if they
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16 claimed the event would not require magic, a score of 1 if they claimed it would require a little
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18 magic, and a score of 2 if they claimed it would require a lot of magic. For punishment
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20 judgments, participants received a score of 0 if they claimed the actor did not deserve
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22 punishment, a score of 1 if they claimed the actor deserved a little punishment, and a score of 2 if
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24 they claimed the actor deserved a lot of punishment. For each participant, these scores were then
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26 averaged across the four events within each category within each judgment block. As in Study 1,
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28 we then analyzed scores in three ways: (1) by computing how often the events were judged not
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30 magical and not punishable, (2) by computing within-domain differences between domain-
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32 relevant law violations (e.g., punishment judgments of immoral events) and the other three kinds
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34 of events, and (3) by computing between-domain differences between magic scores and
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36 punishment scores for the impossible events and immoral events.
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43 **Results**

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45 **Control items.** As in Study 1, we compared judgments for the ordinary events to a score
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47 of 1.0, which corresponded to claiming that the event required either “a little magic” or “a little
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49 punishment.” For both types of judgments, the mean score for all age groups was significantly
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51 less than 1.0 (younger children: M magic score = 0.38, $t(27) = 5.38$, $p < .001$; M punishment
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53 score = 0.30, $t(27) = 7.09$, $p < .001$; older children: M magic score = 0.12, $t(45) = 21.13$, $p <$
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55 $.001$; M punishment score = 0.21, $t(45) = 14.26$, $p < .001$; adults: M magic score = 0.02, $t(77) =$
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57 186.34 , $p < .001$; M punishment score = 0.01, $t(77) = 260.91$, $p < .001$). These data indicate that
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4 participants of all ages understood the task and the scale, claiming that ordinary events require
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6 neither magic nor punishment. Once again, our remaining analyses focus solely on judgments for
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8 the abnormal events.
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11 **Within-domain distinctions.** Participants' tendency to judge each type of event magical
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13 or punishable is displayed in Table 2. We used one-way analyses of variance (ANOVAs) to
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15 assess the effects of age group on each type of judgment for each type of event. Participants'
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17 tendency to judge that particular events would not require magic (i.e., that they were possible)
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19 increased with age for unconventional events ($F(2,149) = 8.50, p < .001, \eta^2 = .10$) and immoral
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21 events ($F(2,149) = 12.02, p < .001, \eta^2 = .14$) but decreased with age for impossible events
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23 ($F(2,149) = 31.18, p < .001, \eta^2 = .30$). Contrast analyses confirmed that these effects varied
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25 linearly across age group (impossible events: $F(1,149) = 52.65, p < .001, \eta^2 = .25$;
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27 unconventional events: $F(1,149) = 16.99, p < .001, \eta^2 = .10$ immoral events: $F(1,149) = 24.00, p$
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29 $< .001, \eta^2 = .14$). No reliable age effects were observed for the improbable events ($F(2,149) =$
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31 $2.86, p = 0.06, \eta^2 = .04$) because adults claimed these events would require "a little magic"
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33 unexpectedly often (25% of the time).
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41 Participants' tendency to judge that particular events did not require punishment (i.e., that
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43 they were permissible) increased with age for impossible events ($F(2,149) = 21.91, p < .001, \eta^2$
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45 $= .23$) and improbable events ($F(2,149) = 8.16, p < .001, \eta^2 = .10$) but decreased with age for the
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47 immoral events ($F(2,149) = 17.03, p < .001, \eta^2 = .19$). Contrast analyses confirmed that all three
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49 effects were linear in nature (impossible events: $F(1,149) = 25.49, p < .001, \eta^2 = .13$; improbable
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51 events: $F(1,149) = 10.82, p = .001, \eta^2 = .07$; immoral events: $F(1,149) = 32.78, p < .001, \eta^2 =$
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53 $.18$). No age effects were observed for the unconventional events ($F(1,149) = 1.94, p = .147, \eta^2 =$
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55 $.03$), as younger children claimed that these events were permissible (i.e., not punishable) at
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57 higher rates than they did in Study 1.
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4 Difference scores between law-violating events and regularity-violating events are
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6 displayed in Figure 3. From a normative perspective, only the impossible events violate physical
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8 laws and thus only impossible events should be judged as requiring magic. Likewise, only the
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10 immoral events violate moral laws and thus only the immoral events should be judged as
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12 requiring punishment. We assessed how well participants were able to make these distinctions by
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14 submitting participants' difference scores to mixed-measures 3 x 3 ANOVAs, with event
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16 comparison (e.g., impossible/immoral vs. impossible/improbable vs. impossible/unconventional)
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18 entered as the within-participants factor and age group (younger children vs. older children vs.
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20 adults) entered as the between-participants factor.
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26 For magic judgments, this analysis revealed main effects of event comparison ($F(2,300)$
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28 = 26.85, $p = .001$, $\eta^2 = .02$) and age group ($F(2,150) = 84.94$, $p < .001$, $\eta^2 = .51$), as well as a
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30 significant interaction between them ($F(4,300) = 9.22$, $p < .001$, $\eta^2 = .01$). Improbable events
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32 were differentiated from impossible events less than immoral events were ($M = 1.19$ vs. $M =$
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34 1.41 , $t(304) = -2.72$, $p = .007$, $d = 0.31$) and less than unconventional events were ($M = 1.19$ vs.
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36 $M = 1.40$, $t(304) = -2.53$, $p = .012$, $d = 0.29$), but unconventional events were differentiated from
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38 impossible events to the same degree as the immoral events were ($t(304) = 0.12$, $p = .906$, $d =$
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40 0.01). With respect to age, younger children differentiated impossible events from other events
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42 less than older children did ($M = 0.53$ vs. $M = 1.08$, $t(213) = -6.87$, $p < .001$, $d = 0.89$), and older
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44 children differentiated impossible events from other events less than adults did ($M = 1.08$ vs. M
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46 = 1.78 , $t(185) = -11.29$, $p < .001$, $d = 1.40$). The interaction between event type and age group
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48 occurred because adults differentiated improbable events from impossible events less strongly
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50 than they differentiated unconventional and immoral events from impossible events, but this
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52 pattern was less pronounced in older children and absent in younger children.
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4 For punishment judgments, the mixed-measures ANOVA revealed main effects of event
5 comparison ($F(2,300) = 56.17, p < .001, \eta^2 = .07$) and age group ($F(2,150) = 31.93, p < .001, \eta^2$
6 = .26). Unconventional events were differentiated from immoral events less than improbable
7 events were ($M = 0.78$ vs. $M = 1.06, t(304) = -4.17, p < .001, d = 0.47$) and less than impossible
8 events were ($M = 0.783$ vs. $M = 1.19, t(304) = -5.70, p < .001, d = 0.65$). With respect to age,
9 younger children differentiated immoral events from other events less than older children did (M
10 = 0.49 vs. $M = 0.86, t(223) = -4.06, p < .001, d = 0.56$), and older children differentiated immoral
11 events from other events less than adults did ($M = 0.86$ vs. $M = 1.29, t(370) = -7.53, p < .001, d =$
12 0.81). The interaction between event type and age group was marginal ($F(4,300) = 2.283, p =$
13 .060 $\eta^2 = .006$), and it occurred for the same reason as the interaction described above:
14 participants' differentiation of immoral events from other events varied by event for some age
15 groups slightly more than others.
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33 In sum, these findings parallel those of Study 1; we found consistent effects of event type
34 and age group for both types of domain-specific judgments. We also found that the effects of
35 event type were substantially smaller than the effects of age group (possibility judgments: $\eta^2 =$
36 .02 vs. $\eta^2 = .51$, permissibility judgments: $\eta^2 = .07$ vs. $\eta^2 = .26$). These findings further confirm
37 that the ability to differentiate law-violating events from regularity-violating events varies only
38 slightly by event but varies substantially with age.
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48 **Between-domain distinctions.** For impossible events and immoral events, how well did
49 participants differentiate the extent to which they require magic from the extent to which they
50 require punishment? To answer this question, we subtracted punishment scores from magic
51 scores. The mean difference between these scores is displayed in Figure 4, as a function of age
52 group.
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4 One-way ANOVAs revealed that difference scores varied by age group both for the
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6 impossible events ($F(2,149) = 76.53, p < .001, \text{partial } \eta^2 = .51$) and the immoral events ($F(2,149)$
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8 $= 19.99, p < .001, \text{partial } \eta^2 = .21$). Contrast analyses revealed that difference scores increased
9
10 linearly across age groups for the impossible events ($F(1,149) = 108.44, p < .001, \text{partial } \eta^2 =$
11
12 $.42$) but decreased linearly across age groups for the immoral events ($F(1,149) = 39.66, p < .001,$
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14 $\text{partial } \eta^2 = .21$). That is, younger participants were less likely than older participants to judge
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16 that events requiring magic (impossible events) did not also require punishment and to judge that
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18 events requiring punishment (immoral events) did not also require magic. This finding was not
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20 driven solely by differences between children and adults. Among just the children, age (in
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22 months) was correlated with stronger magic scores relative to punishment scores for the
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24 impossible events ($r(74) = .27, p < .05$) and stronger punishment scores relative to magic scores
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26 for the immoral events ($r(74) = -.56, p < .001$). Thus, older children viewed questions about
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28 magic and questions about punishment as more distinct than younger children did for both
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30 immoral and impossible events.
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38 Discussion

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40 The findings of Study 2 closely replicate those of Study 1 despite the change in how the
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42 judgments of possibility and permissibility were elicited. The ability to differentiate events that
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44 violate domain-relevant laws from other types of abnormal events increased with age, as did the
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46 ability to differentiate the modal domains themselves. These findings are particularly noteworthy
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48 when considering that children's prior experience with punishment would have pertained
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50 exclusively to violations of moral principles, and that children's prior experience with the
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52 concept of magic would have pertained exclusively to violations of physical principles. Yet,
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54 despite such differences in prior experience, most younger children claimed that it would take
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56 magic for a person to do something immoral (e.g., lie or steal) and that a person who does
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4 something impossible (e.g., float in the air or conjure an object out of nowhere) deserves
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6 punishment.
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9 Consistent with the idea that the questions used in Study 2 were more domain-specific
10 than those used in Study 1, we found that older children and adults were less inclined to judge
11 impossible, improbable, and unconventional events as punishable than to judge them as wrong.
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13 That is, older children's punishment scores for events that did not violate any moral laws
14 averaged 0.7 in Study 2, whereas their impermissibility scores for those same events averaged
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16 0.9 in Study 1, and adults' punishment scores for events that did not violate any moral laws
17 averaged 0.3 in Study 2, whereas their impermissibility scores for those same events averaged
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19 0.6 in Study 1. These data confirm our suspicion that the unexpectedly high impermissibility
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21 ratings among older children and adults in Study 1 may have been an artifact of the question.
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30 31 **General Discussion**

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33 When making judgments of physical possibility and judgments of moral permissibility,
34 which both recruit modal cognition, how well do young children differentiate events that violate
35 domain-relevant laws from events that violate other kinds of regularities? And how well do they
36 differentiate the domain of physical possibility from the domain of moral permissibility in
37 general? In two studies, we have shown that preschool-aged children are not adept at either kind
38 of differentiation. They claim that events that are improbable but do not violate any physical
39 laws, like getting into a movie for free or convincing a sibling to clean one's room, are
40 impossible and would require magic to occur. Moreover, they claim that behaviors that are
41 unconventional but do not violate any moral rules, like eating a bug or wearing pajamas to
42 school, are wrong and should be punished if they occur. Finally, when preschoolers regard an
43 event as impossible, they also often claim that it is impermissible, and when they regard an event
44 as impermissible, they also often claim that it is impossible.
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4 This latter finding is particularly telling of the way in which young children conceive of
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6 events that are precluded by physical or social principles. They recognize that these events will
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8 not occur or should not occur, but they seem not to identify the specific principle that precludes
9
10 them. Without identifying that principle, an event that is precluded for physical reasons (e.g.,
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12 floating in the air) is also viewed as being morally precluded, and an event that is precluded for
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14 moral reasons (e.g., lying to a parent) is also viewed as physically precluded. Adults draw a
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16 sharp distinction between these two senses of preclusion, but young children apparently do not.
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21 It is important to keep in mind that conflating questions of physical possibility and moral
22
23 permissibility is not the same as conflating physical causation and psychological causation.
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25 Children as young as three recognize that some actions are mediated by physical causes (e.g.,
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27 lifting an object depends on how heavy the object is) and others are mediated by psychological
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29 causes (e.g., finding a bowl in a kitchen depends on knowing where the bowls are kept; see
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31 Kalish, 2004; Schult & Wellman, 1997; Sobel, 2004). Thus, when children in the present study
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33 claimed that floating in the air is wrong or that lying to a parent is impossible, it's unlikely they
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35 were confused about the mechanisms that might bring about these events. Rather, they appear to
36
37 be deficient in their ability to represent an event as meeting one set of modal criteria but not
38
39 another. Children's apparent default for thinking about non-actual events is to represent them
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41 either as something that can happen or as something that cannot. It requires some additional
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43 capacity or effort to represent the particular reason that a given event cannot happen. Children
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45 may know implicitly that physically abnormal events and morally abnormal events violate
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47 different kinds of regularities, but they do not appear to consult that knowledge when making
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49 judgments that involve non-actual possibilities.
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58 One of the more striking aspects of what we've uncovered is that young children judge
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60 immoral events to be impossible even in cases where they are likely to have committed these acts
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4 themselves (e.g., lying to a parent, taking something from a classmate). This aspect of our
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6 findings cuts sharply against what would be predicted by constructivist theories of moral
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8 development. We suspect that one likely explanation of this pattern is that children are not
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10 conceiving of *their own* actions as moral or immoral (or at least not to the same extent that they
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12 moralize others' actions). This hypothesis is supported by research showing that young children
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14 often believe that moral norms apply to others' behavior more than to their own, predicting that
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16 others will act in accordance with moral norms more than they themselves will (and more than
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18 they, in fact, do; see, Chernyak & Kushnir, 2014; Smith, Blake and Harris 2013). Future work
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20 should directly explore this issue by asking children about the possibility of their own (vs.
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22 others') immoral actions.
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29 At the same time, the fact that children *do know* something about physical regularities
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31 and social norms potentially explains why their conflation of modal distinctions is relative rather
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33 than absolute. In neither study did we observe a complete lack of differentiation between target
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35 events or target questions; all mean difference scores were greater than zero, even for our
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37 youngest participants. While children's ability to make modal distinctions increases with age,
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39 they exhibit some initial competence nonetheless. What might account for that competence?
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43 One possibility is that our youngest participants had already begun developing the
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45 capacity to make within- and between-domain distinctions in the same way that older children
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47 and adults do—i.e., by tagging the event as a violation of some particular law or regularity—but
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49 they were not practiced at doing so. Thus, younger children may have successfully identified the
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51 nature of the violation on occasion but defaulted to a conflated sense of modality on all other
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53 occasions.
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58 Another possibility is that young children were aided by the content of the events
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60 themselves. Within a domain, the distinction between law-violating events and regularity-
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4 violating events is implicitly conveyed by the egregiousness of the violation. Within the context
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6 of reasoning about what is possible, for example, improbable events must strike young children
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8 as abnormal, but impossible events must strike them as even more abnormal. Young children
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10 may be sensitive to this degree of abnormality and use it as a way of assessing the extent to
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12 which an event violates domain-relevant regularities. Between-domain distinctions are also
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14 implicitly conveyed by the content of the events under consideration. Impossible events may
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16 have activated knowledge of physical regularities more so than social regularities, and immoral
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18 events may have activated knowledge of social regularities more so than physical regularities.
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20 Such differences in knowledge activation may have effectively focused children's attention on
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22 one set of modal considerations (e.g., those relevant to physical possibility) rather than another
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24 (e.g., those relevant to moral permissibility).
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31 In line with this view, many of the physical violations we used as stimuli were
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33 sufficiently separated from the social domain that even young children may have thought that
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35 social considerations did not apply. A ball instantaneously appearing on a person's head, for
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37 instance, has little to do with mental states or interpersonal relations, and children may have
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39 viewed such an event as simply beyond the purview of moral rules (as it is). That said, the robust
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41 developmental differences observed between our younger participants and our older participants
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43 suggests that the ability to make clear and consistent modal distinctions requires explicit
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45 identification of the principle being violated and its status with respect to the modal question at
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51 hand.
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53 On a broader note, our findings have implications not just for the development of modal
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55 cognition but also for the architecture of mature modal cognition. As noted in the Introduction,
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57 there are deep similarities between the language used to express physical possibility and the
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59 language used to express moral permissibility (Kratzer, 2012; Portner, 2009). There are also deep
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4 similarities between adults' reasoning about physical possibility and their reasoning about moral
5 permissibility (Bear & Knobe, in press; Shtulman & Tong, 2013). Our findings suggest that
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7 those similarities are not coincidental. Modal distinctions—either distinctions within a domain or
8
9 between domains—appear to be secondary to the more general (and simpler) distinction between
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11 events that are precluded by prior knowledge and those that are not. Put differently, people of all
12
13 ages may focus on events that are *normal* in a given situation and ignore the events that are not,
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15 including impossible events, improbable events, unconventional events, and immoral events.
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19 Adults are able to distinguish among abnormal events if pressed to do so, but those distinctions
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21 may be less fundamental to everyday modal reasoning than simply distinguishing what is normal
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23 from what is not. Indeed, Phillips and Cushman (2017) found that even adults judge immoral
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25 events to be impossible when they are forced to make these judgments quickly and do not have
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27 enough time to reflect on the reasons that a particular event is or is not precluded.
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34 This emerging picture of modal cognition aligns closely with the capacity that has been
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36 theoretically posited by researchers working on high-level judgments. For instance, researchers
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38 working on causation have suggested that causal judgments rely on some representation of the
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40 alternative events that could have occurred but did not (Lewis, 1973; Pearl, 2000; Woodward,
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42 2006). Critically though, people do not treat all alternative events equally when making causal
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44 judgments; they tend to represent alternative possibilities only when those possibilities are not
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46 immoral, improbable, unconventional or impossible (Gerstenberg & Tenenbaum, 2017; Halpern
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48 & Hitchcock, 2015; Icard, Kominsky & Knobe, 2017; Kominsky, Phillips, Gerstenberg,
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50 Lagnado, & Knobe, 2015; Phillips & Cushman, 2017). A similar capacity has also been
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52 independently posited by researchers working on moral judgments, judgments of freedom, and
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54 modality in natural languages (Stalnaker, 2002; Kratzer, 2012; Phillips, Luguri & Knobe, 2015).
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56 Accordingly, the form of modal cognition that adults have been posited to rely on may be deeply
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4 related to the modal reasoning we have observed in young children (for a theoretical argument
5 along these lines, see Phillips & Knobe, *forthcoming*). Future empirical research should continue
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7 to explore the centrality of modal cognition to other forms of higher-order cognition.
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10 11 **Conclusion**

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14 The ability to differentiate what *could* occur from what *should* occur develops gradually
15 over the first decade of life. It does not come for free with an intuitive theory of physical laws or
16 social rules. To be able to differentiate the events that cannot happen physically from those
17 should not happen socially, children must learn to tag events not only as unusual or unlikely but
18 as precluded by specific kinds of principle that impose specific kinds of constraints. Piaget
19 (1948) once speculated that “[social] rules are naturally placed by the child on the same plane as
20 actual physical phenomena. One must go to bed at night, have a bath before going to bed, etc.,
21 exactly as the sun shines by day and the moon by night, or as pebbles sink while boats remain
22 afloat. All these things are and must be so; they are as the World-Order decrees that they should
23 be, and there must be a reason for it all” (p. 191). Our findings support Piaget’s speculation; the
24 youngest children in our study treated violations of physical rules similarly to how they treated
25 violations of moral rules and vice versa. Distinguishing one type of violation from the other is
26 not an inherent feature of modal cognition; it is a developmental achievement.
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Table 1

The mean proportion of events judged possible (could happen in real life) or permissible (okay to do in real life) for each type of event and each age group in Study 1.

		Younger children	Older children	Adults	<i>F</i>
Possible	Impossible	.31	.14	.02	31.38***
	Improbable	.53	.79	.83	18.64***
	Unconventional	.56	.91	.97	67.07***
	Immoral	.53	.89	.96	54.59***
Permissible	Impossible	.48	.52	.64	3.28*
	Improbable	.57	.45	.58	2.19
	Unconventional	.39	.44	.54	5.19**
	Immoral	.16	.08	.02	12.87***

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 2

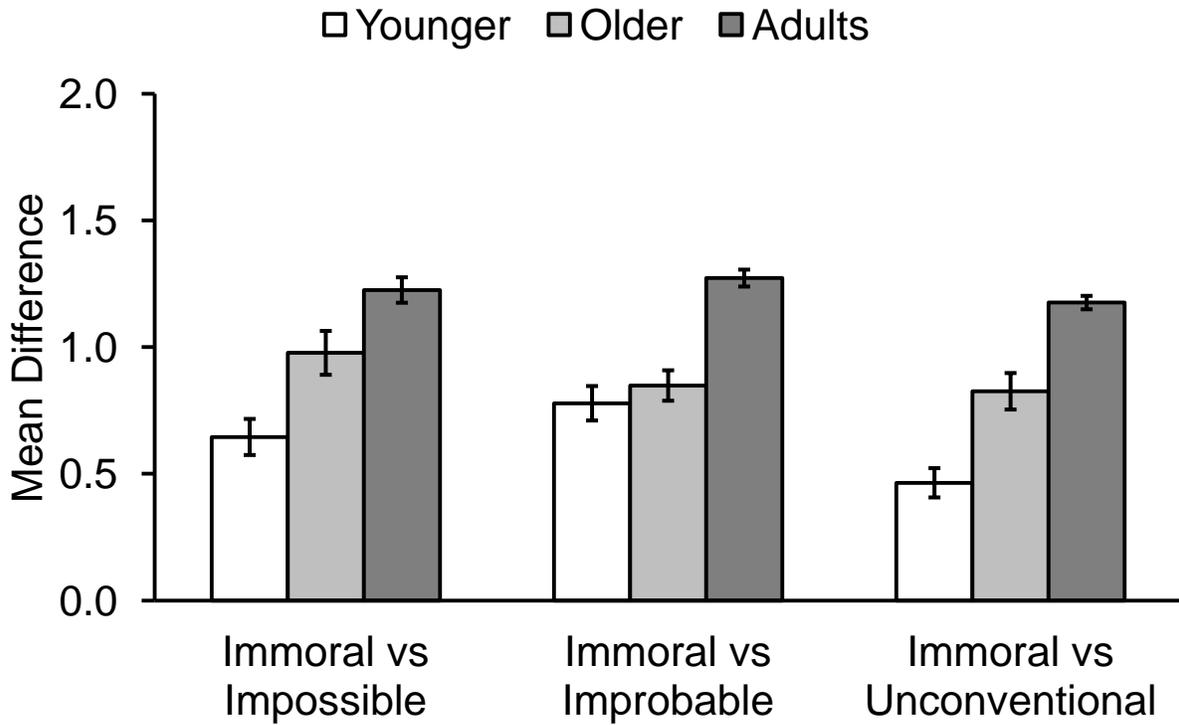
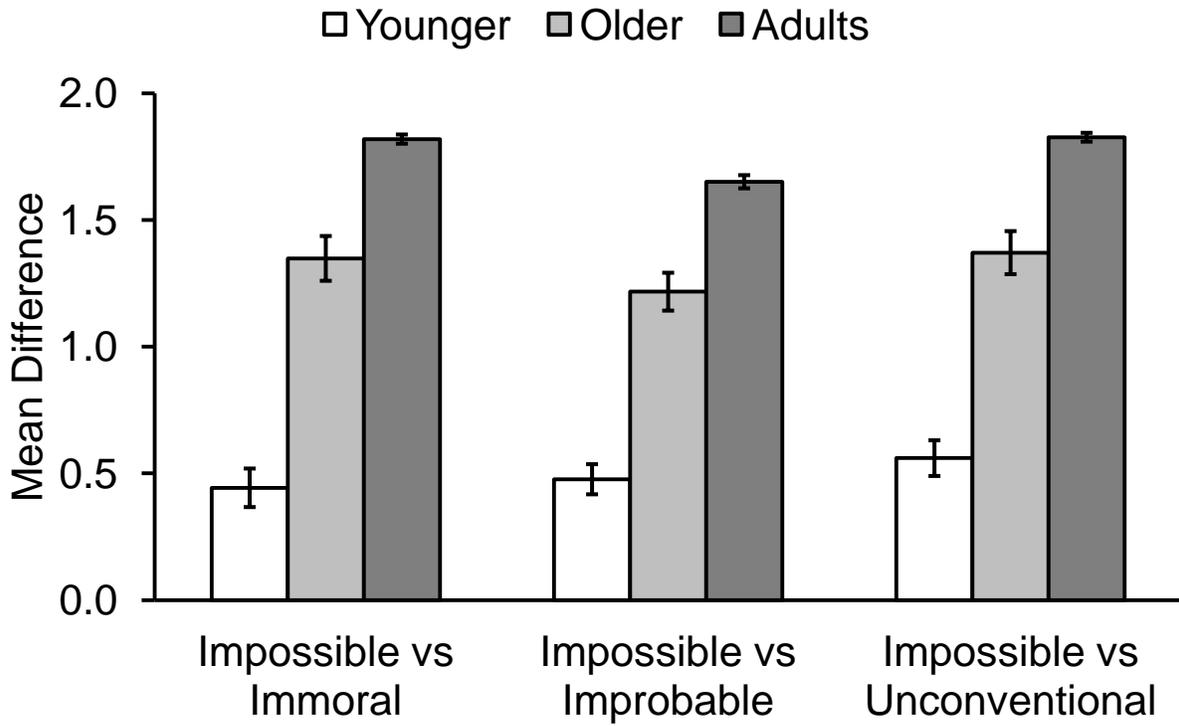
The mean proportion of events judged possible (would not require magic) or permissible (would not require punishment) for each type of event and each age group in Study 2.

		Younger	Older	Adults	<i>F</i>
		children	children		
Possible	Impossible	.43	.27	.01	15.27***
	Improbable	.72	.82	.69	2.86
	Unconventional	.76	.90	.95	8.50***
	Immoral	.75	.91	.96	12.02***
Permissible	Impossible	.65	.67	.95	21.91***
	Improbable	.60	.63	.79	8.16***
	Unconventional	.46	.44	.53	1.94
	Immoral	.29	.14	.03	17.03***

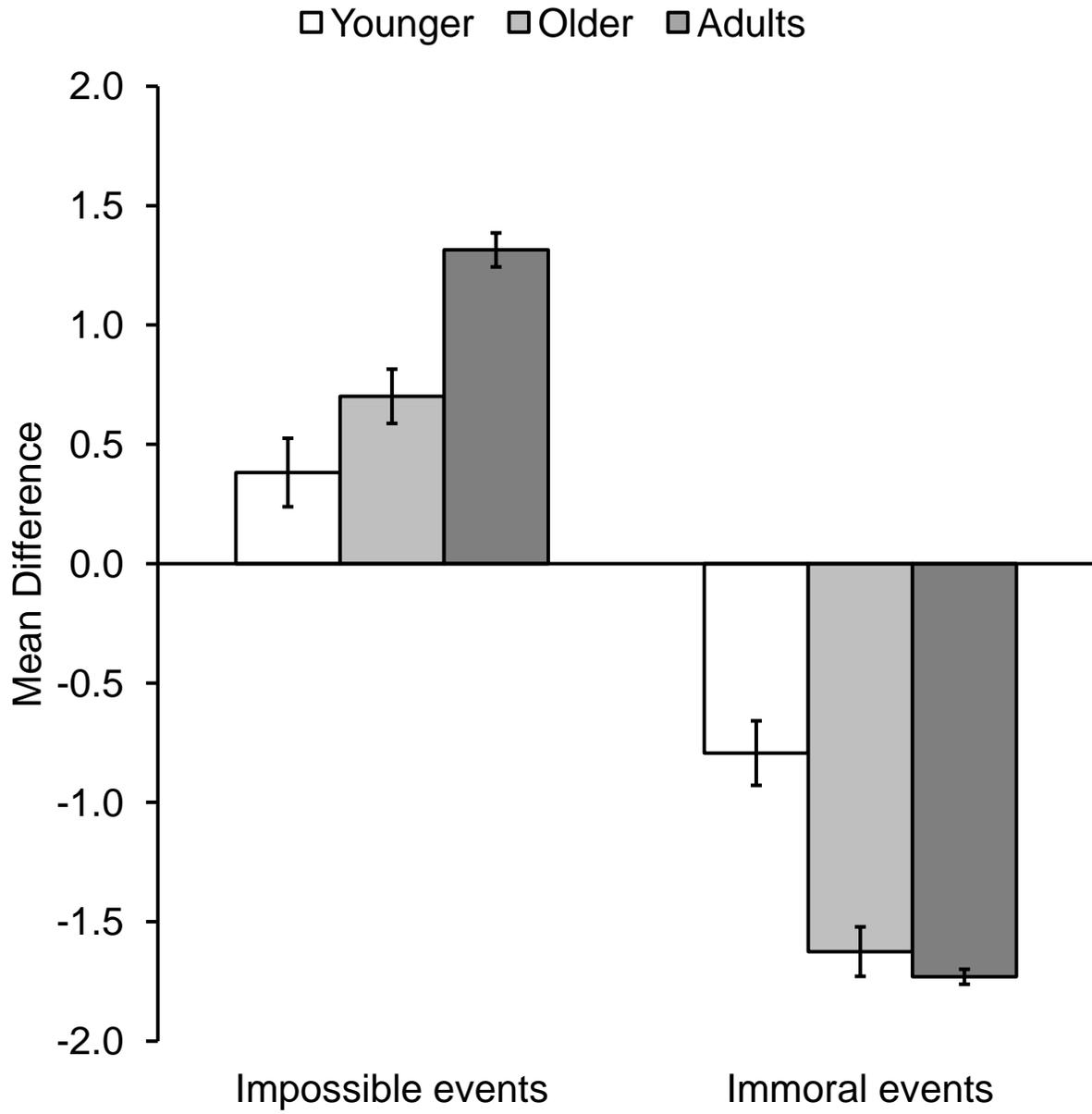
p* < .05, *p* < .01, ****p* < .001

Figure Captions

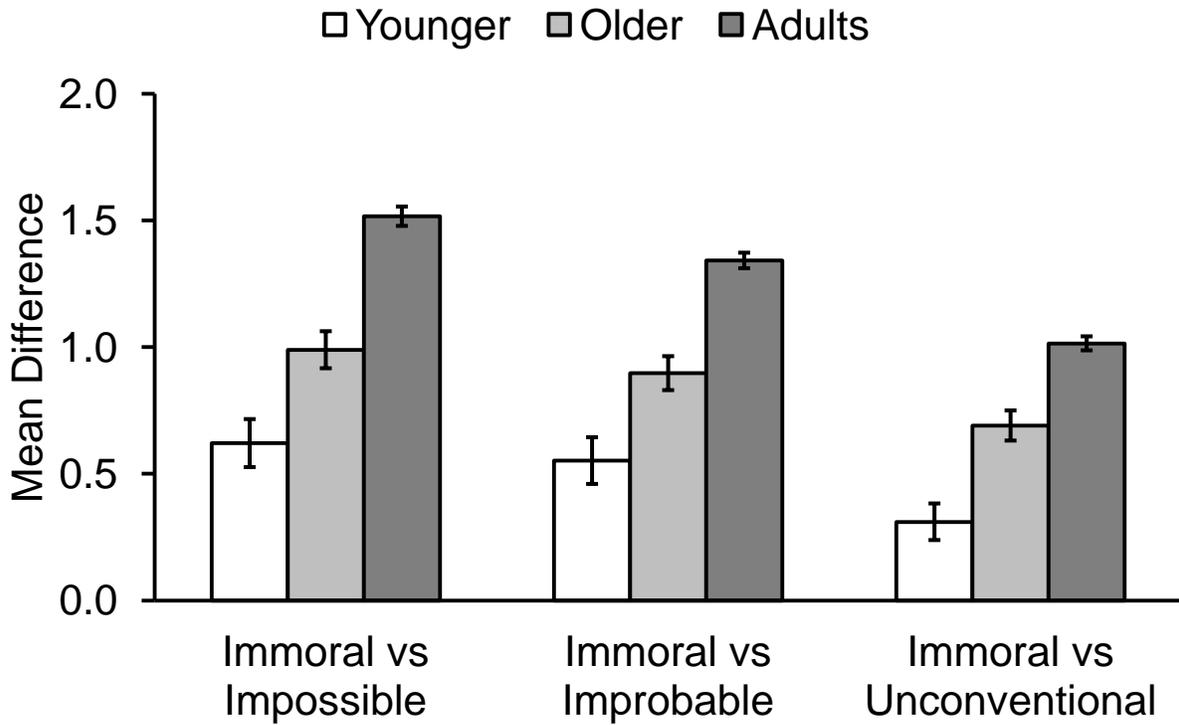
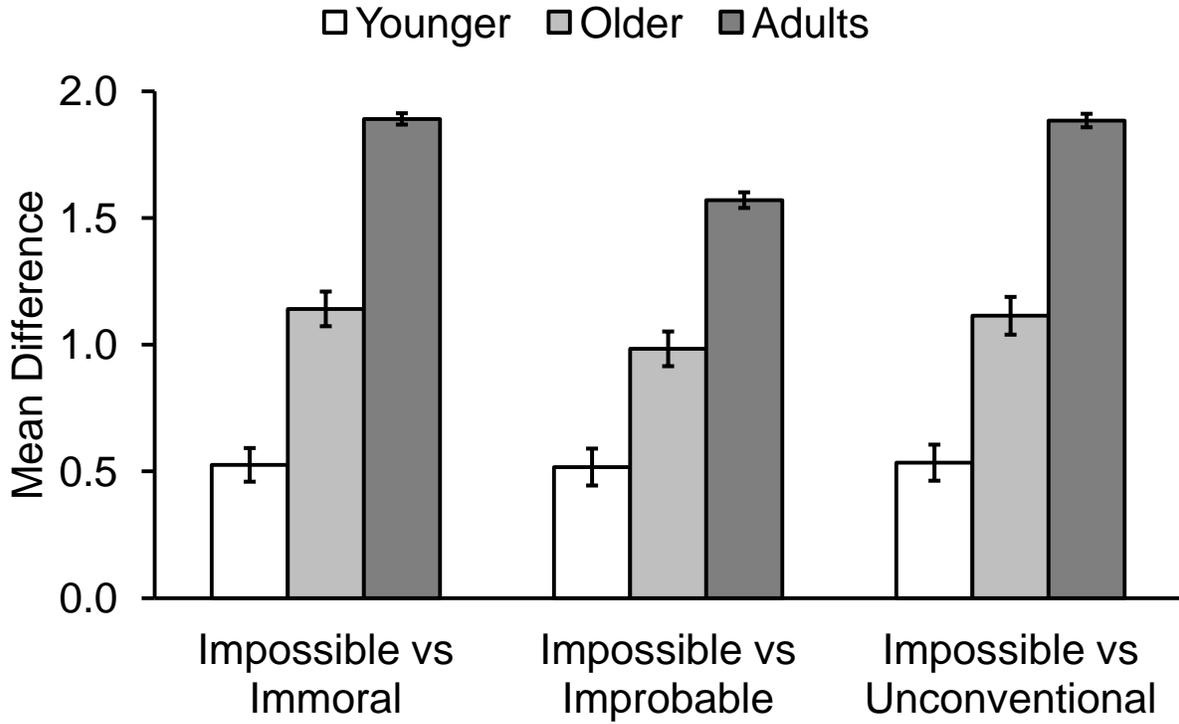
1. Within-domain differences, Study 1: Mean difference in possibility scores between the impossible events and all other events by age group (top panel) and mean difference in permissibility scores between the immoral events and all other events by age group (bottom panel). Error bars represent *SE*.
2. Between-domain differences, Study 1: Mean difference between possibility scores and permissibility scores for impossible events and immoral events by age group. Positive scores indicate stronger judgments that the event is impossible; negative scores indicate stronger judgments that the event is impermissible. Error bars represent *SE*.
3. Within-domain differences, Study 2: Mean difference in magic scores between the impossible events and all other events by age group (top panel) and mean difference in punishment scores between the immoral events and all other events by age group (bottom panel). Error bars represent *SE*.
4. Between-domain differences, Study 2: Mean difference between magic scores and punishment scores for impossible events and immoral events by age group. Positive scores indicate stronger judgments that the event would require magic; negative scores indicate stronger judgments that the actor deserves punishment. Error bars represent *SE*.



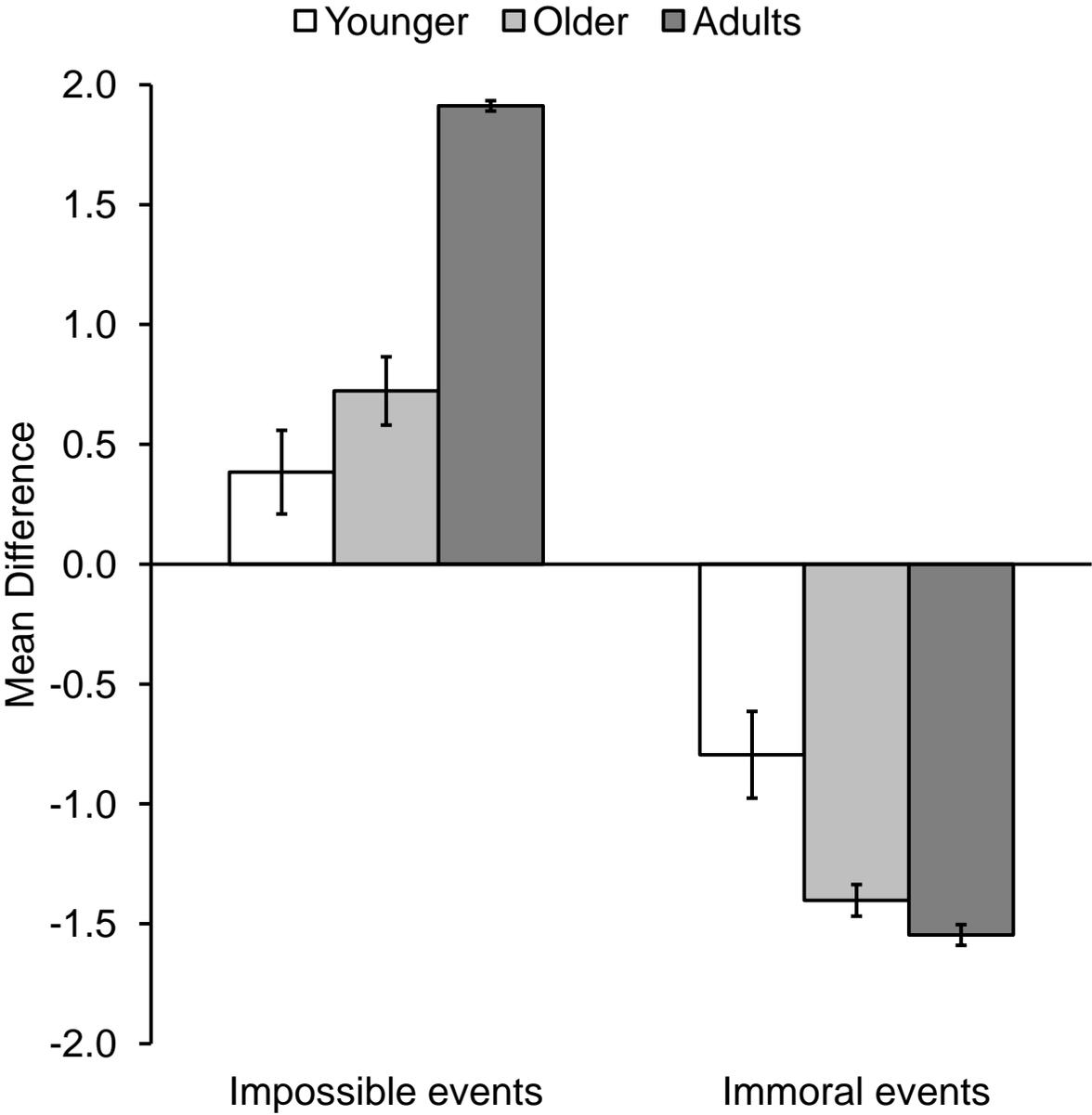
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Appendix

This is Henry. Henry is standing in line at a grocery store when he sees some candy he really wants. He asks his mother if she will buy him the candy, but his mother says no. So...

- Henry waits to get home to eat his favorite snack. [ordinary]
- Henry throws his hat in the air and it turns into the candy he wants. [impossible]
- Henry tells the man at the store that he should get all the candy in the store for free, and the man gives it to him. [improbable]
- Henry buys the candy with his own money and then waits until he is alone in his room to eat it. [unconventional]
- Henry takes the candy without paying and doesn't tell his mother. [immoral]

This is Annie. This is Lisa. Lisa is playing with her ball, and Annie wants to play with the ball too. But Lisa says that she wants to play with the ball by herself. So...

- Annie asks Lisa if she wants to play on the swings with her, and Lisa agrees. [ordinary]
- Annie claps her hands loudly and a new ball appears on top of her head. [impossible]
- Annie tells Lisa that balls aren't fun to play with, so Lisa gives the ball to Annie forever. [improbable]
- Annie tells the teacher that Lisa won't share, and the teacher makes Lisa give Annie the ball. [unconventional]
- Annie gets mad and takes Lisa's ball away when Lisa is playing with it. [immoral]

This is Melissa. Melissa doesn't want to go to school because she doesn't want to leave her mother. She always misses her mother a lot when she goes to school. So...

- 1
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4 • Melissa and her mother agree to do something special after school and that makes
5
6 Melissa feel happy. [ordinary]
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8
- 9 • Melissa snaps her fingers and suddenly it's Saturday so she doesn't have to go to school.
10
11 [impossible]
12
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- 14 • Melissa asks her mother to go to school with her, and her mother agrees and goes to all
15
16 her classes. [improbable]
17
18
- 19 • Melissa decides to wear her pajamas to school because wearing pajamas make her feel
20
21 happy. [unconventional]
22
23
- 24 • Melissa lies to her mother and tells her that school is closed today so that she doesn't
25
26 have to go. [immoral]
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31 This is Tom. This is Elliot. Tom and Elliot both wants to play on their school's basketball team,
32
33 but there's room for only one of them. Elliot is better at basketball, so Tom thinks that Elliot will
34
35 be picked for the team. So...

- 36
37 • Tom decides to try out for the soccer team instead of the basketball team. [ordinary]
38
39
- 40 • Tom jumps into the air and floats above the ground so he becomes taller and better at
41
42 basketball. [impossible]
43
44
- 45 • Tom tells Elliot that doing chores is more fun than basketball, so Elliot decides not to try
46
47 out for the team. [improbable]
48
49
- 50 • Tom tells the basketball coach about something bad that Elliot did, and the coach won't
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52 let Elliot tryout for the team. [unconventional]
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- 55 • Tom trips Elliot so that Elliot falls and hurts his knee and can't play basketball anymore.
56
57 [immoral]
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7 This is Jimmy. Jimmy sees a boy standing in line at a movie theater with a ticket in his back
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9 pocket. Jimmy also wants to see a movie at the movie theater, but he doesn't have a ticket. So...

- 10
- 11 • Jimmy goes back home and watches a movie on TV instead. [ordinary]
- 12
- 13 • Jimmy finds a tree with movie tickets growing on it and picks one. [impossible]
- 14
- 15 • Jimmy asks the ticket person if he can see the movie for free, and she lets him.
- 16
- 17 [improbable]
- 18
- 19 • Jimmy tells the boy how the movie ends and the boy decides he doesn't want to see the
- 20
- 21 movie anymore and gives Jimmy his ticket. [unconventional]
- 22
- 23 • Jimmy steals the boy's ticket when he is buying popcorn. [immoral]
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31 This is Lauren. Lauren wants to play with her friends, but her parents say she has to clean her
32
33 room first. So...

- 34
- 35
- 36 • Lauren tells her friends that she needs to clean her room and her friends help her so they
- 37
- 38 can play together sooner. [ordinary]
- 39
- 40 • Lauren turns the lights off in her room and when she turns them back on, her room is
- 41
- 42 instantly clean. [impossible]
- 43
- 44 • Lauren pays her sister a penny to clean her room for her, and her sister agrees.
- 45
- 46 [improbable]
- 47
- 48 • Lauren cleans her room by shoving all her clothes and toys under the bed and then goes
- 49
- 50 to play with her friends. [unconventional]
- 51
- 52 • Lauren lies to her mother and says she cleaned her room and goes to play with her friends
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- 54 without cleaning up. [immoral]
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7 This is Ralph. This is John. Ralph is at John's birthday party. When it's time for cake, Ralph
8
9 finishes his slice and wants to eat more, but the rest of the cake is gone. So...

- 10
- 11 • Ralph eats a slice of watermelon instead. [ordinary]
- 12
- 13
- 14 • Ralph waves his hands over his plate and a new slice of cake instantly appears there.
15
16 [impossible]
- 17
- 18
- 19 • Ralph tells John's mother that he is still hungry, and she brings him a cake of his very
20
21 own. [improbable]
- 22
- 23
- 24 • Ralph waits until everyone clears their plates and then searches the trash for any leftover
25
26 cake. [unconventional]
- 27
- 28
- 29 • When John is not looking, Ralph steals John's cake off his plate and shoves it in his
30
31 mouth. [immoral]
- 32
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36 This is Sophie. Sophie is making a loaf of bread to sell to her neighbor. Just as she's about to
37
38 finish the dough, a big hairy spider falls in. So...

- 39
- 40
- 41 • Sophie throws the dough away and makes new dough from scratch. [ordinary]
- 42
- 43
- 44 • Sophie uses a time machine to go back in time and catch the spider before it falls into the
45
46 dough. [impossible]
- 47
- 48
- 49 • Sophie tells her neighbor that a spider fell into the dough, and her neighbor buys the
50
51 bread anyway. [improbable]
- 52
- 53
- 54 • Sophie bakes the dough anyway and eats the bread herself. [unconventional]
- 55
- 56 • Sophie bakes the dough anyway and sells the loaf of bread to her neighbor without telling
57
58 him about the spider. [immoral]
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Highlights

- Investigated how well children make modal distinctions within and across domains.
- Preschoolers often conflated violations of laws and violations of mere regularities.
- They also often conflated possibility and permissibility.
- Many judged immoral events impossible and impossible events immoral.
- Our findings suggest the difference between “could” and “should” must be learned.